CIVIL ENGINEERING

Published by the American Society of Civil Engineers

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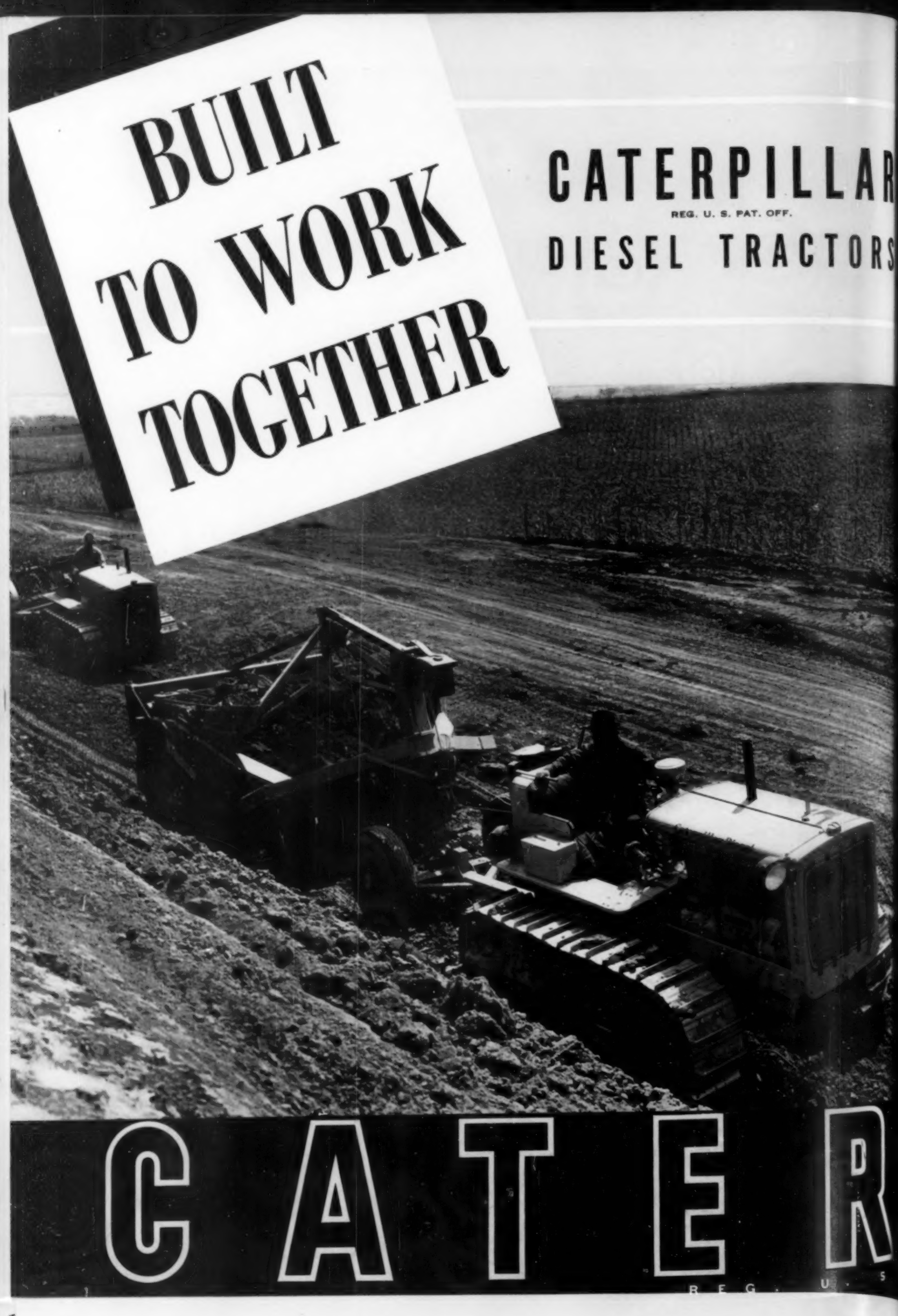
PART OF THE TRIBOROUGH BRIDGE, LINKING THREE OF NEW YORK CITY'S FIVE BOROUGHS
The East River Suspension Span Appears Behind the Hell Gate Arch. Description of the Entire Project on Page 515

Volume 6 — AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852 — Number 8

AUGUST 1936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Among Our Writers

DANIEL W. MEAD, President of the Society and an eminent hydraulic consultant, has unswervingly supported the highest ideals of professional conduct throughout his 52 years of activity in engineering. In the light of his contacts with so many careers in all stages, few can speak as ably as Dr. Mead on the importance of a code of ethics applicable to the entire membership.

ROBERT STEPHENSON, two years after graduation from Columbia University, explored the interior of Bolivia and Peru as assistant topographer with the National Geographic Society. Other colorful engineering engagements have taken him to Canada, to the Dominican Republic, and to various other South American countries.

E. A. LAWRENCE has had close to 30 years of experience in the design and construction of water works and sewerage improvements for various Ohio municipalities. In 1910 he became a partner in the firm of Jennings, Lawrence, and Lindsey (since 1917 the Jennings-Lawrence Company).

A. M. EDWARDS has been associated with the Columbus Bureau of Water Works Extension since 1920. As assistant engineer he has been for some years in charge of design and construction of city intake dams, filter plants, pumping stations, and water mains.

EDWARD A. RAMSEY studied architecture at Columbia University, and conducted his own architectural practice in Columbus, Ohio, from 1920 until 1923. When Mr. Ramsey took charge of the Columbus incinerator project he was given the title of designing engineer.

E. WARREN BOWDEN has been assistant to the chief engineer, Port of New York Authority, since 1928, employed on construction of the George Washington and Bayonne bridges and the Midtown Hudson Tunnel. For the past $2^1/_2$ years he has been jointly employed by the Triborough Bridge Authority.

M. F. TRICE has been a staff member of the Division of Sanitary Engineering of the North Carolina State Board of Health for the past 10 years. His work has included general supervision of municipal water purification and sewage treatment works, and the study of stream pollution by sewage and industrial wastes.

D. H. OVERMAN, as designing engineer of bridges in charge of detail design, Ohio State Highway Department, has been in direct charge of many large bridges, including the Lorain Road Viaduct at Cleveland, awarded first prize in Class B, A.I.S.C. bridge competition for 1935.

VOLUME 6 NUMBER 8

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CIVIL ENGINEERING

August 1936

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Number 8

The Engineer and His Code

Recent Events Indicate the Need for Universal Acceptance of a Broad Code of Ethics

By Daniel W. Mead

President and Honorary Member, American Society of Civil Engineers
Professor Emeritus, Hydraulic and Sanitary Engineering, University of Wisconsin; Consulting Engineer, Madison, Wis.

Addressing the Society's Sixty-Sixth Annual Convention at Portland, Ore., on July 15, 1936, President Mead emphasized that to accomplish its full purpose any code of ethics should be applicable to the entire membership, covering as far as possible the best thoughts on the duties of the engineer in all his activities. As a sort of reaction to the sacrifices of the World War, general business and social ideals were lowered following the armistice. But the concept of service, as later exemplified by the Society's Code of Ethics, was already highly developed among professional men. Lately we have been passing through a period of unemployment and economic stress, a time when many condemn rather than praise industry and invention. The work of the engineer is far from completed, however, and as high professional standards are essential to future progress, universal acceptance of a comprehensive code of ethics has never been more necessary than at present.

Great crises frequently bring into play high ideals and are met by great sacrifices, even from those from whom such action would be least expected. In the stir and excitement of such events the spirits of men are exalted to meet, undaunted, almost any contingency. But when the excitement subsides, when the crisis is over, the selfish spirit of personal advantage returns; the love of country again becomes subordinated to the love of self.

The persistent exercise of the higher ideals, as a basis of life and action—which is often of even greater importance than a supreme sacrifice to the continued development of civilization—requires continued and unremittent effort which human nature, in the main, is apparently too weak to sustain. It has been said that it is easier to die for one's country than it is to live for one's country.

War always seems to bring out both the best and the worst in the people of a nation. In the World War in which we engaged "to save the world for democracy," hundreds of thousands willingly took up arms; thousands gave their health and their lives; and millions laid aside their own affairs and eagerly accepted service for the common good. After the armistice, in many cases these high ideals rapidly faded away; the motive of personal advantage returned almost immediately, often greatly accentuated; action and reaction were equal. In the backwash of post-war events, the worst frequently came to the fore; sorrow, suffering, and sacrifice had exhausted the patience and forebearance of the people of many nations. Democracies were born and hastily abandoned because they did not immediately entail Utopia. In some nations liberty has been destroyed and dictatorships have been established, throwing additional doubts on an uncertain future.

In our own country, recovery and readjustment seemed at first to be rapid, but it was a false recovery, based on extravagant hopes and resulting speculation. Low moral standards seemed to have gained the ascendency in political, financial, social, business, and, to an extent, in professional life. Such low ideals can by no means be entirely attributed to the War and its consequences for many such ideas antedate that event by many years.

Corporation and financial ethics have been for many decades in a chaotic condition. The history of many corporations, dating back over a long period, brought to light corporate practices in perhaps their worst phases and, while the most reprehensible of the practices on which these organizations were erected, have been eliminated, further restraint seems necessary for the welfare of the nation.

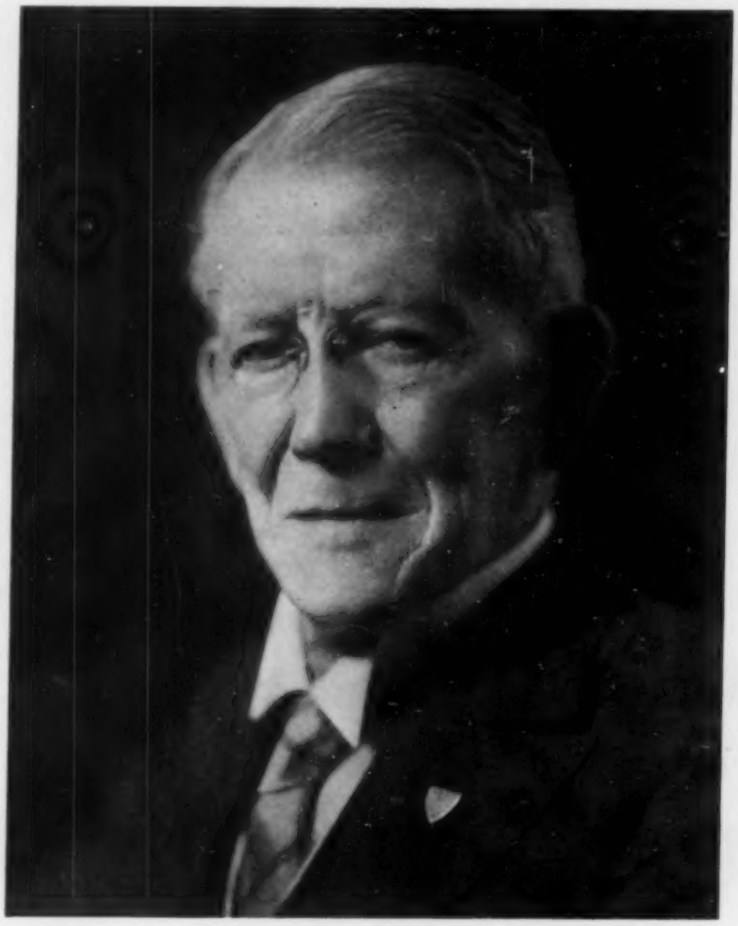
This century, and the closing years of the last century, witnessed the creation of many corporations which at times secured such great financial power and political control that they were able to ride roughshod over the rights of individuals and communities. The impersonality of such corporations has led their officials to disregard human rights and frequently human laws and to exercise their powers, to the great detriment of the nation, in ways which even the members of such corporations would never as individuals have desired or have dared to attempt.

These examples have had a depressing effect on the ethical standards not only of those exercising these powers but of many business and professional men who have been associated with them or who have been affected by them until the "law of the jungle" seemed at the time to have become the rule of business.

During this same period, however, there has been a development of higher ideals in the thoughts of the best

professional and business men. The idea of the necessity of "service" as a sound fundamental requirement of professional and business activities has become dominant. Many codes of ethics and rules of conduct have been adopted, and although many who have recognized the desirability and necessity of such codes have not always observed them, when they could be ignored to individual advantage without too severe a reaction, there has been a distinct improvement in ethical ideals. Such codes always have been and perhaps always will be objective ideals to be approximated as nearly as practicable. Some of the principles declared in these codes, however, are so important that their observation is essential to common decency and honesty, and the lack of their observance should disbar the offender from his association with honorable men. Such are the principles embodied in the present code of the American Society of Civil Engineers.

During these last decades the federal and the state governments have passed regulatory laws and have organized utility, rate, railroad, and trade commissions which have been able to eliminate many objectionable corporation practices, and the way seemed open to a gradual and satisfactory adjustment of professional and trade practice.



DR. DANIEL W. MEAD
President American Society of Civil Engineers

GOVERNMENT EXTENDS ITS CONTROL OF BUSINESS

The objectionable practices of the past, however, under the immediate excuse of the depression, are the apparent cause of the federal government attempting to take over the control of the business of the country, and are the only apparent excuse for the construction of competing power plants built by the federal government itself and by the federal financing of competitive plants constructed by municipalities.

It must be remembered that these private corporations are organized under law. Their securities were issued under the supervision of the states, and such securities have been sold under the laws of the states to millions of innocent purchasers who have had nothing to do with the management of the corporations. While the states have made no guaranty of permanency or of adequate returns on investments, they did to all intents and purposes guarantee a fair deal and honorable treatment to the corporations and to the investors. It cannot be maintained that our government has met these conditions on any higher ethical plane than that which previously had been used by business.

I hold no brief for those who favor the law of the jungle in finance, in business, or in government, and I am entirely in sympathy with every reasonable effort to control improper individual and corporate initiative for the benefit of our social advancement. I cannot remain neutral when I believe that recovery would respond immediately to the establishment of confidence in a fair and equitable governmental control and that under such condition unemployment would soon be a thing of the past.

Many engineers will find it difficult to square high ideals with conditions that now exist or with the new doctrine that they are now asked to accept. Although the very foundation of the engineering profession is based on the belief that improved production, improved facilities, and new inventions and discoveries will add to the happiness and welfare of the people of our nation and that such results brought about by the engineers of the country are worthy of the highest praise, the engineer is now asked to believe that, in the future the road to national advancement, to happiness, and to prosperity should, with the single exception of power supply, be based on a doctrine of scarcity and high prices. Under this doctrine the few will profit at the expense of the many, and the unfortunate will do without. Under this doctrine he who makes "two blades of grass to grow upon a spot of ground where only one grew before," is to be condemned rather than praised. Under this doctrine the days of development are past, and the engineer must confine his attention simply to maintenance and modification of the things that are. The doctrine is not only destructive to engineering ideals, but it is false and vicious. If I know the engineers of the United States, as I do believe that I do, they will not accept this doctrine of despair, this principle of pessimism.

THE IMPORTANCE OF THE ENGINEER IN SOCIAL PROGRESS

Much still remains to be done for the further advancement and improvement of our country, for the protec-

tion and welfare of our people, for the happiness and contentment of our citizens. The work of the engineer is not completed; we shall go on to greater things in the future than the past has ever known.

The doctrine of plenty needs for its success only an adjustment in exchange and not a cessation of effort, in order that all may benefit. The problem of exchange can and will be solved, and with abundance the needy shall be fed not on the enervating basis of charity, except to the helpless, but on a fair basis of an exchange of effort that shall arouse a feeling of manhood and womanhood instead of apathy and dependence in a free and self-reliant people. There is even hope that the principles of economics and politics may some day be better understood and be placed on a uniform, sound, honest, and intelligent basis. On this doctrine of abundance, the engineers of the nation will take their stand.

Since the birth of our nation there has never been a time when intelligence, sound judgment, high ideals, and an unwavering stand for honesty, fair play, and a square deal, have been more needed than at present, and such ideals and ideas should find their firmest support from the professional men of our nation.

CODES OF ETHICS SHOULD APPLY TO ALL

The Code of Ethics of the American Society of Civil Engineers, which in effect is a code of laws for the members of our Society, and the codes of most other engineering societies, apply most directly to the small percentage of engineers in general practice, and only remotely to the large majority of the membership. It seems highly desirable that a code of ethics and of conduct, perhaps advisory rather than mandatory, should be adopted which will be applicable to our entire membership.

A code of ethics for the engineering profession is somewhat complicated by the fact that the profession contains many men who are not engaged exclusively in independent engineering practice nor employed by those in such practice; it includes also many engineers employed in public works—federal, state, and municipal—as well as those who are officials of transportation, utility, manufacturing, or contracting corporations, or who are employed by such corporations. There are also engineers engaged in promotional and financial operations.

The American Institute of Architects requires that its members shall not personally be interested in the building trades or be under personal obligation to manufacturers or others whose products enter into work under their supervision. The American Institute of Consulting Engineers requires that its members shall be in independent practice and not be connected with contracting or promotion, except in a purely advisory or supervisory capacity.

SOCIETY MEMBERSHIP INCLUDES A DIVERSIFIED GROUP

The American Society of Civil Engineers cannot limit its membership in any such manner, as many of its most valued members comprise not only those who are engaged in independent engineering work, but also those in all the various activities just mentioned and in various combinations of those activities and who, in the course of time, change from one occupation to another. Therefore, it becomes difficult but even more essential to prepare a code of ethics which will be reasonably applicable to the entire fraternity of engineers.

Although high ideals are essential to moral progress in the development of civilization and for the future welfare of the nation and of the professions, it must be recognized that such ideals must be limited by the actual conditions of life. A supreme sacrifice is possible in a crisis, but long-continued service must involve some consideration of the one who serves if such service is to continue. "The laborer is worthy of his hire." Personal consideration of self, family, dependents, and the ordinary duties of life are also of primary importance in a practical world. The nice adjustment between service and self is the real difficulty in the way of the successful application of any ethical code. Such a code of ethics, therefore, should cover as far as possible the best thoughts on the duties of the engineer in all his activities. The profession is equally interested in the consulting engineer and the engineer in general practice, and in the engineer in public works, in the service of corporations, in various combined relations, in business, in expert legal work, and in the subordinate positions of the profession, and also in the student who is intending to enter the profession.

I am greatly interested in the engineering students for they are the men who will take the place of those of us whose professional work will soon be over. They are the men who in the future will make the profession great if they possess great ability and high ideals. The profession owes a duty to these young men to see that they appreciate the necessity of high attainments and that they are informed concerning both the privileges and the duties of our great profession. At the present time many of these young men are leaving their alma maters without any information, other than technical, as to their duties as citizens and as engineers; many are morally injured by unfortunate associates or employment, due to their ignorance of professional ideals.

The educational committee of the American Institute of Architects is apparently taking great pains to see that the important matters of professional relations are discussed in all architectural schools. While a knowledge of professional ideals is of great importance to all professional students, it seems to be doubly important to the student of engineering who is to enter a profession so complicated in its manifold relationships. The profession owes to these young students, to the public, and to the profession itself, a clear statement of the best thoughts and the highest practical ideals concerning the duties of the engineer in all his relations in life.

BENEFITS TO BE DERIVED FROM A COMPREHENSIVE CODE

It is my greatest hope that by the careful preparation of such a code the opportunity will be available for all engineers to review frequently the ideals of their profession and improve their relationships with the public and with their fellow engineers and associates; that through the pressure of this Society and its other coordinate societies, an understanding of these ideals shall be brought to every student of engineering; and that ultimately the ideals of honor, integrity, and dependability shall predominate in all the relations of our great profession.

Transportation for a Wildcat Oil Camp

Rugged Terrain and Hostile Savages Hamper Road and Rail Construction in Colombian Jungle

By Robert Stephenson

Associate Member American Society of Civil Engineers
New York, N.Y.

TRANSPORTING machinery and supplies constitutes the most serious difficulty of prospecting work in the oil regions of Colombia. Access by river to the low-lying section adjacent to the Venezuelan border here described may be had only during the three-month season of the "big rains." The nearest railroad point is 25 miles distant over a precarious trail passable only to pack animals. Rugged, densely wooded country, tropical heat, fever-bearing insects, and intransigent Carib aborigines add their quota to the discomforts and difficulties of the work. Under such conditions the construction of roads and narrow-gage rail lines presents problems of major proportions. Mr. Stephenson's article describes the work in an interesting manner, showing how the cheapness of native labor and the inability to transport any but a few small units of earth-moving equipment completely reversed the usual economics of the job.

In the spring of 1934 I went to Colombia to work on the location and construction of roads and a narrow-gage railroad for transporting machinery and supplies to wildcat wells being drilled on a concession in the eastern part of the country. The area where the drilling was being done lies along the Venezuelan border, in low, hot jungle country traversed by several large rivers with numerous tributaries, which drain into the Maracaibo basin. The altitude varies from about 100 ft above sea level to 1,000 ft on some of the higher ridges.

The concession (Fig. 1) is a strip about 125 miles long and some 30 miles wide, lying nearly north and south. The southern half is comparatively low, broken country cut by one high, sharp ridge, but the northern half is extremely rugged. The whole area is densely wooded with typical jungle growth. Sandstones and shales form the underlying rock. The rainfall shows the same variation as the topography—from 100 in. per year in the southern half to 275 in. in the northern. While rain falls all year it is especially heavy in the so-called rainy season, from late September to the end of the year. Another period of very heavy rainfall may occur in June, but this cannot be depended upon.

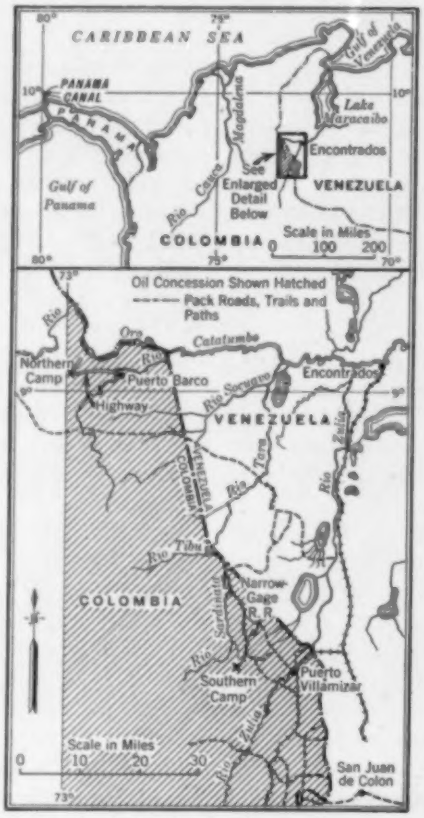


Fig. 1. Sketch Map Showing Location of Oil Concession

Because of the remoteness of the region, transportation was the most serious problem. All heavy equipment, railroad material, drilling machinery, and tractors had to be brought from Venezuela up the rivers on barges, and this could only be done during the three months of the rainy season. The hauling was started in early October, and had to be completed before the end of the year. In the northern section of the concession the river haul was about 80 miles and in the southern a little longer. Towing was done by launches, which drew strings of two or three barges. During the dry season the northern end of the concession was still accessible by water for smaller launches, which kept up communication, brought in food supplies, and transported labor. In the southern part, food and other necessary light supplies were brought in over a very difficult trail by pack animals from the nearest rail point in Colombia about 25 miles distant.

Of the two drilling camps, the southern presented the fewer difficulties in transportation. It was about $3^3/_4$ miles from the river and was connected with it by a railroad of 24-in. gage laid with 30-lb rails. As drilling progressed, the track was pushed forward to the new location, and rig, boilers, and other equipment were moved up by rail. Light gasoline locomotives were used first with short flat cars on two-wheeled trucks, and later with flat cars of regulation length on four-wheeled trucks equipped with brakes, as the track was pushed forward to the head of the valley where the rougher country required steeper grades.

At the northern camp the problems of transportation were much more difficult. Since the extreme ruggedness of the topography made a railroad impracticable, it was decided to establish the camp at the river and to build a highway to the well site, which was about $3^3/_4$ miles from the river and at an elevation of about 490 ft above it.

Location methods for both highway and railroad were almost identical. We had fairly good maps of the areas to be drilled, prepared by the geologists, using a plane table. They had also established coordinates and placed some monuments. The location of each well was given by coordinates. The procedure of locating both highway and railroad was first to calculate the distance and bearing from an established point on subgrade or from the monument most convenient to the well location. A direct line was then run. From this direct line preliminary locations were made, gradually working out a practical route.

A great deal of work on these preliminary lines was often necessary owing to the dense jungle cover. In one case, owing to the broken character of the country, 8.7 miles of preliminary line had to be run to locate 1.9 miles of track. Staking and leveling 1,000 ft of final location was an average day's work. Parties of 16 to 20 men were necessary for the best work, most of them

cutting line. Heat, mosquitoes, red bugs, and ticks all helped to slow up the work.

A maximum grade of 3 per cent was fixed for the railroad. The maximum curvature was a 20-deg metric curve, having a radius of about 190 ft, which corresponds to a 30-deg foot curve. In rough topography curves of 130-ft radius were sometimes used where a more economical location was demanded. All grades were compensated for curvature but no easements were used.

For the highway work a maximum grade of 12 per cent was first tried, but the excessive rainfall made drainage and maintenance so difficult that these grades were cut to 9 per cent. In later work the maximum was 8 per cent. Trucks were used for the lighter hauling and tractors with trailers for heavy work. It was found that the maximum curve practical was one of about 65-ft radius.

BUILDING A RAILROAD WITHOUT MECHANICAL EQUIPMENT

Construction of the railroad was performed entirely by hand labor although machinery could have been used to advantage on the heavier work. The first $3^3/_4$ miles of track through comparatively easy country from the river to the camp had been built by hand labor, and a precedent was thus established. Nothing could change this policy. The width of grade on fills was 9.8 ft for main-line tracks and 6.6 ft for spurs. In cuts a drainage ditch of 3.3 ft was added on each side. Slopes were one to one in cuts, which lessened the number of slides in the rainy season considerably, although the blue-clay shales were a continual source of trouble. A 9.8 or 13.1-ft cut made, ditched, and carefully trimmed in the dry season, would often develop cracks when the rains started and would break several yards back from the slope.

The grading work as well as the track work was done by labor contract, the company furnishing tools and subsistence for the men and paying a unit price per cubic meter of earth moved. This expedited the work. Groups of 25 to 30 men worked together and were able to earn considerably more than the peso a day which was the prevailing rate for labor. The yardage varied a great deal, from 4,200 cu yd per mile in the easier part to 8,400 cu yd in rougher country.

Ties and bridge timbers were cut from native timber along the right of way by contract. It was found best to let this work to one contractor as timber of serviceable species was scattered. The best timber was generally found on the lower slopes, often more than half a mile from the track. This made it advisable to employ a native contractor who had had more experience in cutting local timber than the engineers, and who could constantly supervise the work. It also required a fairly large outfit and necessitated frequent moving of the camp.

Quarters for White Men in the Main Camp

When ties were wanted, the men picked the largest trees available, and not, as we do in the north, the smaller trees which would yield one tie to the cut. First the tree was felled and cut into tie lengths. If it was over 36 in. in diameter, the bolts were split with charges of black powder. Finally, the ties were split out with wedges and faced on four sides with axes. A good tree would often make two hundred or more ties.

The railroad bridges, all of 13.1-ft (4-m) span, consisted of timber bents which will give at least two years of service. Later they will be replaced by permanent structures if conditions justify. Owing to the methods of construction, 10 per cent or more of the track was on these trestles. They were cheaper to build than fills of over 9.8 ft (3 m) in height. With hand labor and no other means of moving dirt than wheelbarrows and buckets of 1-cu m capacity mounted on trucks, it was never feasible to utilize material from cuts in making large fills. Material from cuts over 130 ft long was wasted and fills were made from adjacent borrow pits. This added considerably to the cost but was justified by the temporary nature of the work and the lack of the equipment necessary for doing more permanent work. Only the development of an oil field will justify a permanent road. If such a road

Unloading Materials and Supplies for Building a Camp
Launches Towed Strings of Two or Three of These Barges Upstream During the Rainy Season, from Late September to the End of the Year

CLEANING UP A SLIDE WHICH BLOCKED THE ROAD
Note the Guard with Rifle in Left Foreground. The Indians Rarely Attacked Armed Men

becomes necessary, probably 60 per cent of these trestles can be replaced by fills with pipe culverts for drainage.

ROAD CONSTRUCTION EQUIPMENT NEEDED

Constructing a highway for the northern camp was a much more difficult undertaking. Work had been started with hand labor before adequate studies were made. The general plan was to follow the ridges in order to minimize drainage problems. The country was broken into steep, narrow, and unstable ridges with slopes of about 1 on 1, and sandstone bluffs were common. Slides were frequent where clay shales were encountered, and progress was slow. A good deal of time had been lost, and two engineers had been forced to leave because of fever before it was finally decided to ship in adequate machinery to complete the road within a reasonable time. A gasoline shovel of $^{1}/_{2}$ cu yd capacity, a compressor for jackhammers, and a heavy caterpillar tractor equipped with a bulldozer were later supplied.

An additional force of 250 men was kept for ditching and finishing, for working the lighter cuts by hand, and for running the camps. In addition to the river camp, a laborers' camp for the men doing hand work was established about three miles from the river. Food supplies had to be taken from the end of the finished road by packers to this camp, which meant a great deal of extra trail building.

The normal width of the final road was to be 19.7 ft (6 m). Before starting the new section, it was necessary to revise the $1^{1}/_{4}$ miles of road already built, cutting grades to a 9 per cent maximum, providing drainage, and surfacing with river gravel. The shovel was then moved up. Because of its small capacity it was run on two shifts, from daylight to noon and from noon to dark, a little over 12 hours per day. Work on the next two miles was very heavy. Including slides, it ran well over 4,200 cu yd per mile. Cuts ran up to 33 ft on the upper side, but hillsides were so steep that all material from the shovel could be disposed of by casting over.

A 1 on $^{1}/_{4}$ slope was adopted throughout. This held up very well in sandstone, but in the clay shales no slope seemed adequate and slide after slide occurred. It became the policy to move slides with the bulldozer until enough material had been taken out so that further sliding would not interfere with traffic. Meanwhile work on the last half mile, which offered no difficulty, went ahead by hand labor. The road was completed in four months. Later, when $1^{1}/_{4}$ miles more was built to another location, it was easily completed by the same organization in about two months.

FINISHING A SECTION OF ROAD THROUGH DEEP CUT
The Slope of 1 on $^{1}/_{4}$ Held Up Well in Sandstone But in Clay Shales No Slope Seemed Adequate

While this work normally would have presented little difficulty, it became no small undertaking under existing conditions. Material that missed the last rains was stranded along the river until a chance freshet enabled the launches to bring it in. Although the shop facilities for the upkeep of machinery were fairly good, a major break of any kind always held up the work.

In the outlying construction camps fever was prevalent, and patients had to be shipped to the hospital at the main camp. Any labor estimates always included an additional 10 per cent to take care of the sick.

INDIANS A CONSTANT MENACE

Guards were necessary for all men working in the bush or on the grade because of occasional attacks by Indians. In the northern camp this was often a serious menace and one armed guard was regularly furnished for each ten workmen. At the southern camp these attacks were not so serious, although one man was killed and several were wounded in the course of the work. In the local highway camps, however, there was al-

ways more or less danger. Not only were men shot with arrows but tool boxes were broken open and robbed, and machinery was tampered with and damaged. The favorite plunder of these brush people seemed to be machetes, axes, and any sort of unpainted canvas. They would also take shovels, especially if they were worn. We learned the reason for this when in one of their camps we found steel-tipped hunting arrows, the points of which had been cut from shovel blades. Evidently the older shovels, worn thin, could more easily be worked into arrow points. We also found arrows bound with raveled threads of canvas.

These Indians are generally supposed to be of the Carib race, which once inhabited most of the Maracaibo basin. They have gradually been pushed back or absorbed until only a remnant survive in the region between the Magdelena River and the Lake Maracaibo watershed. This remnant is a wild bush people who refuse to make any contact with outsiders and resent any encroachment on their limited territory. All efforts we made to get acquainted with them were without result. They would generally take gifts of salt, cloth, string, or small cooking pots left for them along the grade, but this would not prevent them from shooting at our men if opportunity offered.

They hunt with bow and arrow and have limited plantations of yucca, plantains, and other tropical crops. They live in large community dwellings accommodating as many as a hundred persons. Probably these groups form separate tribes which have little or no contact with other groups. Their trails are well made, cleared for several yards on each side, and provided with primitive log bridges over the smaller streams. They rarely travel the larger waterways. For crossing rivers they build primitive rafts of balsa logs lashed together with vines. Beyond these few facts nothing is known of them. Even the half-tamed tribes in the surrounding country fear them and never go into their territory.

THE RAILROAD WAS BUILT ENTIRELY BY HAND LABOR
But Machinery Could Have Been Used to Advantage on the Heavier Work

All our camps were built with the idea of minimizing attacks by Indians. Clearings at least 650 ft square were made and fenced with heavy barbed wire. A system of floodlights was installed to light a cleared area beyond. Guards were kept at night to patrol the fences. Arrows were sometimes shot into a camp at night but with little effect. The casualties occurred in the field and then only when the men were careless. The shooting of a man created consternation among the workmen, and for several weeks every precaution would be taken. Then after a time they would become careless again and would go into the bush unarmed or in small groups to hunt.

THE NARROW-GAGE RAILROAD RUNS THROUGH DENSE JUNGLE

The Indians seemed to know and respect firearms; it was remarkable how seldom a group with weapons in evidence was molested. Almost every attack was made on unarmed men or men carrying side arms which were probably not visible. The only exception to this was a party of geologists who for convenience had pitched camp on one of the Indian trails. They were attacked repeatedly; one of their camps with all their equipment was destroyed while they were in the field; and they were finally forced to abandon the work.

ROUGH AND READY METHODS PREVAIL IN PROSPECTING WORK

At present an engineer is of minor importance in wildcat oil drilling in Colombia, or, as a manager once told me, he is a "necessary evil." However, it is interesting work which will probably become more attractive to engineers as the oil companies in tropical or other remote regions begin to take more interest in their engineering problems instead of devoting all their energies to prospecting and drilling.

At present the situation is similar to that which existed in the lumber industry thirty years ago; the practical man is in the saddle and methods are more or less haphazard and inefficient. Like the lumber companies, the so-called producing companies are really exploiting what has already been produced by natural processes, and their methods are more or less destructive. As competition becomes more of a factor and oil more inacessible, the trained man will be more in demand.

Constructing Village Water Works and Sewers

The Consulting Engineer Meets a Variety of Diversified Problems in Village Practice

By E. A. Lawrence

Treasurer, Jennings-Lawrence Company, Civil and Municipal Engineers, Columbus, Ohio

While engineering projects entered into by cities are apt to be complicated, village projects often are more diversified, requiring the highest engineering experience and judgment. Consultants to villages must frequently provide financial and legal as well as technical advice. As fees for the design of village water works and sewers are usually payable out of a prospective bond issue, the engineer must gamble on the willingness of the electorate to approve the proposed increase of indebtedness and, even after such assent is given, must rely upon the good faith of the village council in legalizing the terms previously agreed upon. Among the specific problems discussed by Mr. Lawrence are many of considerable importance in providing well and surface water supplies. The article, which is abstracted from a paper delivered before the regional meeting of Local Sections held at Columbus, Ohio, on May 15, terminates with a brief survey of village sewerage problems.

To the layman and to those engineers familiar with large construction projects, the work of planning and constructing water and sewage works for villages may seem elementary. (Ohio law classifies all towns of less than 5,000 population as villages.) In a sense this is true. Hundreds of dollars are involved in villages, as against thousands in cities. Usually the city projects also require more complicated design. However, the water and sewer problems encountered in villages are probably even more diversified than like problems in cities, and almost always require experience and sound judgment to secure the best results. Problems of such a nature should be given careful consideration by competent engineers.

A surprisingly large number of village and smaller city officials are even today unaware of the necessity for competent engineering service. Such men frequently cite the failure or early disintegration of structures built under engineering supervision in nearby villages or small cities as proof that engineers as a whole are just a necessary evil, if in fact necessary at all. Unfortunately, their criticisms are sometimes based on good grounds. The same thought and care must be given to the planning and construction of small projects as are given to the larger works.

Before enumerating any specific problems the general subject of financing village improvements should be mentioned. The average village solicitor is usually inexperienced in the legal or financial procedure necessary to initiate and complete sewer and water improvements. Sometimes this financing proves impossible, and the earlier the proposition is analyzed and the facts discovered the better for all concerned. In cities, where experienced legal departments are maintained and where city auditors are generally alert, the engineering department can usually confine its efforts to the purely engineering aspects of the various projects for which plans are required. In villages, on the other hand, the consulting engineer is almost forced to assist in solving the financial and legal problems.

Laying Sanitary and Storm Sewers at Bexley, Ohio

Gambling That He Will Be Paid for His Services

The engineer for the village improvement is also frequently asked to play another rôle—that of "good sport" and gambler, de luxe model. Under the laws of Ohio, no contract with a municipality is legal or binding until the fiscal officer of the same has attached his certificate to the contract that funds are on hand or in process of collection to meet the contract obligation. Cities usually maintain an engineering staff paid at least in part from tax levy money. Villages normally have no money in any fund available to meet the cost of employing an engineer to make preliminary surveys, estimates, and reports. Such services are expected to be paid for from funds to be realized later, from the sale of bonds. The amount of such bond issue cannot be determined until the engineer's preliminary surveys and estimates are submitted. With no money in the general fund to pay for the report the engineer is frequently asked to go ahead, in spite of the fact that the fiscal officer's certificate is not signed, and gamble that the bonds will some day be issued and sold and that he will then receive his pay under a contract which the state auditor's inspection department may rule is illegal. New councils frequently develop a complex that the preceding council has proceeded carelessly and illegally, and that no so-called illegal contracts will be recognized. The engineer's situation in such cases is painfully apparent. An attempt will be made next year to remedy the situation somewhat in this state.

At the present time, village engineers are called upon to fill still another rôle—that of consultant in PWA and WPA financing and procedure, too often without additional compensation. Thus, there are undoubtedly some marked

differences between the duties of the salaried city engineer and his staff, and those of the engineering consultant on village sewer and water projects.

Some of the problems in water works planning for villages may be enumerated. If the project involves construction of a water works system, then the first problem, aside from financing, is to determine the source of the water supply. In Ohio the first thought usually is of drilling wells. In most communities having no public water supply a strong prejudice exists against a surface source, either filtered or unfiltered. Only after numerous test wells have been drilled and pumped without finding adequate or satisfactory water, will the local officials consent to make plans for a "creek-water" supply, as they usually call it.

The Completed Dam

The Water-Softening Plant

Some Features of the St. Clairsville, Ohio, Water Supply

The experience of the past three years has demonstrated anew that in a considerable part of this state it is extremely difficult if not impossible to secure a well-water supply of sufficient quantity and satisfactory quality to supply a village of one, two, or three thousand population.

Experience has also shown that even though the new well produces an apparently adequate supply when first pumped, it may not continue to do so for an extended period. Continuous pumping for days or possibly weeks at a rate double or triple the expected normal demand on the well may occasionally be necessary to secure data on the probable yield of the well over a period of years, although a 24- or 48-hr test is usually all that is necessary. The depth to which the water is drawn down and the rapidity of recovery of the well immediately following the test are probably the two most important points in determining the expected yield. The character and depth of the strata from which the water is obtained must of course be given proper weight.

DIFFICULTIES WITH MINERALS IN SOLUTION

After the quantity or yield is determined, chemical analysis may show that the water contains objectionable minerals in excessive quantities. Iron and manganese are the two minerals most commonly found. Fluorides are present frequently enough to cause trouble. Existing plants are now effecting a reduction of from 40 to 60 per cent in well water having a fluoride content between $1^1/_2$ and 2 ppm. Plants referred to in the following paragraphs are all located in the state of Ohio.

After drilling over a dozen wells around the village of New Washington, in Crawford County, Ohio, none of which yielded sufficient quantity, it was found necessary to drill still another well that showed on preliminary test that an adequate quantity was available. A partial analysis of the water from the latter well showed the following: Total alkalinity, 308 ppm; alkali carbonates, 271 ppm; phenol alkalinity, 5 ppm; non-carbonate hardness, 0 ppm; total hardness, 37 ppm; iron, 4.0 ppm; manganese, 0.06 ppm; and fluorides, 3.6 ppm. This was a clear case of too great a fluoride content. A surface supply is now being planned for that village. Incidentally the surface supply shows: Iron, 0.7 ppm; fluorides, 0.4 ppm; manganese 0.02 ppm; total hardness, 161 ppm.

In another village relatively shallow drilled wells did not furnish sufficient water. Wells drilled just a little deeper yielded a plentiful supply of—salt water!

A test well sunk for another municipality indicated that sufficient water was available in gravel at a depth of from 70 to 80 ft. Geological data showed no appreciable gravel deposit overlying the rock in this territory, but did indicate the presence of fresh water in the rock strata immediately below the gravel. A well drilled to this rock strata three or four miles away, for a Muskingum Valley project, flowed as an artesian well, the water being reported as of satisfactory quantity. The municipality sank the 80-ft gravel well about 10 ft farther, penetrating the rock strata some 8 ft. This well produced an abundant supply of water, but here again it proved to be salt water! The hole was successfully plugged, shutting off the salt water from the gravel above. A new hole was then sunk, penetrating the gravel only, a screen was installed, and an adequate and satisfactory supply was secured.

Where chemical content is unsatisfactory, there is an increasing tendency for villages to treat well water supplies either for softening or for simple iron removal. Such treatment plants are being built at a cost of from $7,000 to $25,000, the wide variation being due largely to three factors. These are the type of treatment required; the amount of pumping equipment installed; and the type of building erected, that is, whether the building is plain or ornate.

EXAMPLES OF IRON-REMOVAL PLANTS

The simplest type of treatment is for iron removal only. In the past a conventional iron-removal plant consisted of coke trays and a large reaction basin with the necessary pumping equipment. This type is now used rather infrequently. The modern iron-removal plant consists of some form of aerator, a small reaction cham-

ber, and rapid sand filters. This type is illustrated by the plant at Groveport, now under construction, and that at Cardington, which is under contract. The aerators at these plants will be of the multicone type, which although smaller and of better appearance than the coke trays, are said to be just as efficient. The small reaction chambers in the installations referred to will be steel tanks. The rapid sand filters are of the pressure type. The resulting plant is compact and can be built under contract for slightly over $7,000.

CONCRETE TANK AT ROSEVILLE, OHIO, WATER WORKS

Many well-water supplies in Ohio cause mottled teeth in children because of the fluoride content. Generally, fluoride water also contains iron. The water treatment plant now under construction, at Baltimore, Ohio, is an example of a plant treating fluoride water. The first step in the treatment is aeration through a multicone aerator, lime being added to the water as it leaves the aerator. The small steel reaction basin, previously described, is increased in size to become a settling basin having a 6-hr retention time approximately. Pressure filters are used here as well as in the simpler iron-removal plant. The Baltimore plant will cost between $12,000 and $14,000. Another example of this type of plant is at Leesburg, where the water contains iron and carbonate hardness only. The plant for the treatment of Leesburg water is very similar to that at Baltimore.

The well-water supply at Worthington was inadequate in quantity and unsatisfactory in quality. An adequate supply was obtained from wells properly located and drilled, while a treatment plant answered the question of chemical quality. The water contained some iron, a fairly low carbonate hardness, and a fairly high non-carbonate hardness. The plant consists of a coke-tray aerator, a small concrete reaction basin, and gravity rapid-sand filters, followed by an up-flow zeolite bed. Treatment results in an iron-free water of any hardness the operator desires. The hardness of the treated water depends, of course, upon the amount by-passed around the zeolite bed. The Worthington plant cost about $22,000, even though a part of the old plant was incorporated in the new.

All the plants described are equipped with float and pressure switches controlling the well pumps and high service pumps. As a result the plant is as nearly automatic as is practicable in water treatment. Automatic control and operation are more or less imperative for villages in order to keep the operating costs within bounds. All the plants described also use wells as the source of supply. This indicates the tendency of villages to use well supplies wherever possible, even though the chemical quality of the water may not be good.

TWO COMMON FALLACIES ABOUT WELL SUPPLIES

Before leaving the discussion of a well supply two common fallacies in the development of wells should be mentioned. First, when water in insufficient quantity is encountered, either in rock or gravel strata, some official nearly always suggests "shooting" the well, usually with dynamite. Shooting a gravel well is seldom advisable and then only as a last resort. In fact it is my observation that shooting any well is unsuccessful more times than not.

The other popular belief is that if only a small flow is encountered in a well of small diameter drilled into or through a gravel strata, then a dug well of very large diameter is sure to increase the yield in just about the same ratio as the relative areas. This may or may not follow, depending upon the nature of the strata in which the water is found, the amount of water carried in the strata, and the head or pressure existing. The cost of a dug well is usually out of proportion to the increased yield secured, especially if sunk to any considerable depth, and also out of proportion to securing the same yield by sinking a number of, say, 12-in. drilled wells in the same well field. Again the judgment of the engineer experienced in ground-water supply must be depended upon to determine when a dug well of large diameter is the correct solution, and when it is not.

Having secured a satisfactory well-water supply, the choice of the best pumping equipment is important. A well in which the water stands only 10 or 15 ft below the surface when being test-pumped at the contemplated normal pumping rate always offers a great temptation to install a horizontal centrifugal pump or a displacement-type pump at the surface and attach a 25-ft suction pipe. But if the water level soon lowers under continued daily pumping, or possibly under severe drought conditions, then this type of pump will probably lose suction. A new type must then be installed, and the original pumping units must be sold, usually as junk.

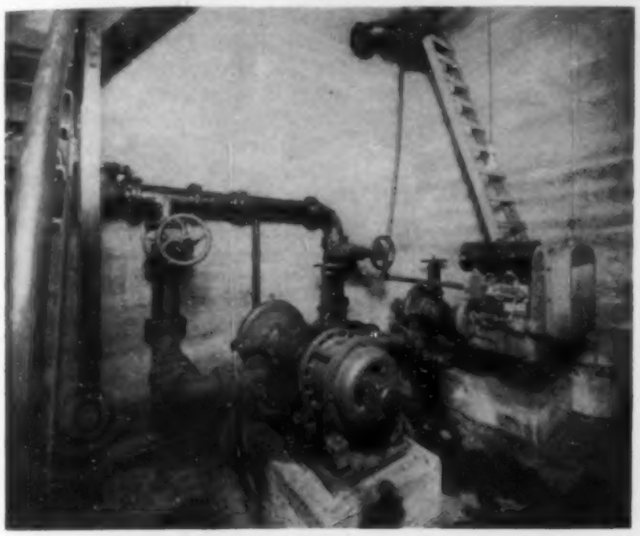
The type of pump now most favored for the ordinary drilled-well installation in the smaller municipalities is the so-called vertical turbine type pump, which is in effect a vertical centrifugal pump with the bowls, or the impeller assembly, placed down in the well at some distance below the surface of the water in the well when it is being pumped. From 10 to 20 ft of suction pipe is usually placed below the impeller assembly.

The efficiency of a reciprocating-type pump, with motor-driven well head and having the cylinder placed in the well at the proper depth, is a little higher usually than is that of the turbine type mentioned in the preceding paragraph. However, first cost and mainte-

nance must be considered as well as operating cost, and again each pumping installation calls for individual study and treatment. Adherence to hard and fast rules and listening to pump salesmen exclusively have led to some rather weird examples of what not to do in choosing pumping equipment.

SECURING SURFACE WATER SUPPLIES

Surface supplies for villages are usually obtained either by the use of an impounding dam suitably located in a small valley, or in flat country, by constructing an up-ground storage reservoir. In the latter case a very small dam is thrown across the stream, usually only high enough to form a "bank-deep" pool. From this pool the water is lifted into the storage reservoir by low-lift pumps, at such times and seasons as the flow in the stream is available. During dry weather the draft on the up-



PUMPS AT THE BEXLEY SEWAGE PUMPING STATION

ground reservoir exceeds the possible pumpage from the pool, and the stored water must meet excess requirements until the reservoir can again be replenished from the pool in the stream.

In some cases the topography is such that no satisfactory form of storage other than an up-ground reservoir is available to the village. In others it is a case of balancing the first cost and operation cost of the reservoir behind an impounding dam against similar costs for an up-ground storage reservoir. When the latter problem was encountered at Blanchester, Ohio, the up-ground reservoir was used.

The earth dam with or without concrete core wall is the most common type of dam used for small impounding reservoirs. Such dams have been built at Cambridge, at St. Clairsville, and at Barnesville. A second dam is now under construction at Barnesville. The latter, situated in a valley adjoining the village in which the original dam and pumping station were built, is so located that approximately two-thirds of an inch of the water stored behind it will flow by gravity to the existing filtration plant at the original pumping site. The spillway design at the St. Clairsville Dam is somewhat unusual in that the lip or mouth of the spillway is at the upper side rather than at the upper end, and is so designed that, as the head of water above the spillway lip rises, the area of the spillway intake increases by an increase in both vertical and horizontal dimensions.

For relatively small dams, spillways must be designed on slightly different assumptions from those for larger dams. The chief difference lies in the relatively large ratio which the surface of the water behind the dam bears to the watershed, and the ratio of the storage capacity of the reservoir above spillway elevation to the maximum runoff of the contributory watershed. Existing design data for large dams with large

SEWAGE PUMPING STATION AND GLASS-ENCLOSED SLUDGE BEDS, VAN WERT, OHIO

watersheds must be evaluated with care if the spillway and freeboard for the smaller dam and smaller watershed are to be safely and economically designed.

In eastern and southeastern Ohio the frequent presence of mud seams in the underlying strata give the engineer designing small earth dams much cause for worry. It is very difficult to shut off the flow of all water from under and around the ends of a concrete core wall. At Cambridge, Ohio, Walter Turner, for many years city engineer, succeeded in making watertight an existing dam leaking through mud seams around the ends of the dam. This was accomplished after several years' work in tunneling and filling mud seams. As a result, the reservoir was filled to spillway elevation. Mr. Turner demonstrated that such mud seams can be sealed by an expenditure of considerable time, effort, and money.

At St. Clairsville the concrete core wall was carried well into solid rock at each end, but when the reservoir was filled, water began to appear from the slope on one side of the valley some distance downstream from the end of the dam. Although the amount of this leakage was not serious, the village officials with the help of WPA labor undertook to tunnel into the hill just downstream from and parallel to the concrete core wall. When this tunnel had been extended about 50 ft into the hill, it appeared that water from the reservoir was following a mud seam or seams into the hill more or less parallel to the face of the core wall. These mud seams turn, crossing the line of the core wall produced, and again turn sufficiently to exit along the face of the valley some distance below the slope of the dam. It is expected that the seams will be sealed and the work completed under WPA.

A rather unusual WPA project which has recently been completed was the construction of a reinforced concrete hollow dam across Alum Creek near the intake of the municipal water works plant at Westerville. This dam is of the overflow type, about 175 ft long, and with a height above upstream creek bed of about 9 ft. The foundation rests on solid shale, and the stream banks above the dam have been raised to well above maximum high-water elevation by constructing an earth levee on either bank. A roadway extends along the north levee, connecting two existing streets.

After the water leaves the pumping station the distribution system must properly yet economically distribute the water for both fire-fighting and for domestic and industrial supply. Since the demand for the former purpose is so much in excess of the demand for all others, distribution for fire-fighting is the determining factor. As regards the proper size of main for a town of two or three thousand, John Goodel in a treatise on water works states that, "The calculation of the size of a pipe needed to furnish a certain quantity of water under given conditions is readily accomplished if approximate results will serve the purpose. If accurate computations are needed, it is allowable to indulge in some complicated algebraic equations if the engineer's mind is made any easier by so doing, but the results do not appear much if any more reliable."

A PART OF THE VAN WERT, OHIO, SEWAGE TREATMENT PLANT

By the use of tables or graphs showing friction losses in pipes the engineer can easily determine the approximate size of pipe required to deliver from the elevated tank or storage the approximate amount of water needed at any given point for fire-fighting. Practically all village water works systems now operate with some form of elevated storage tank or reservoir "riding on the line." This term is used to mean that while the pumps are running, all water not consumed in the system is forced to the elevated tank until the tank is full, when the pumps are stopped—usually by automatic control. Water is then drawn from the tank for consumption until the water in the tank falls to a predetermined level. At that time the pumps are again started, automatically or otherwise, and the cycle is repeated. Naturally, when a fire is being fought, the elevated tank supplies most of the water even if the pumps are running.

Too many village systems have been laid out with the large main coming from the well rather than from the storage tank. Too many long 4-in. lines have been extended unduly and small 4-in. hydrants placed thereon, valuable property being thus imperiled. A valuable school building at Cadiz, Ohio, burned to the ground a few years ago because insufficient water was available at the hydrants near the school building. Examination showed that the original water works distribution system was well designed—even rather generously designed, in fact. Subsequently, probably without engineering advice, supply lines of a size having only about one-fourth the carrying capacity of the original main were extended for a considerable distance toward the school house. This is a rather striking example of so-called "economy."

Another town of over 4,000, not far from Cadiz, depends entirely on small 4-in. hydrants for protection of its entire mercantile and factory area. A full-sized 6-in. barrel hydrant now costs only about $12 to $15 more than a small 4-in. barrel hydrant.

Elevated storage tanks in Ohio villages are almost universally of steel construction. Probably over half are of 100,000-gal capacity, and of such height as to provide an approximate pressure of 50 lb per sq in. in the main part of the village. Usually, where hills are conveniently near, flat-bottomed steel tanks or reinforced concrete reservoirs are constructed. The relative cost is generally about the same. Frequently village officials prefer the concrete reservoir, believing it will give them cooler water in the summer time.

SOME GENERAL CONSIDERATIONS IN SEWERAGE WORK

Much that has been said concerning water works projects in villages applies almost equally to sewers and sewage treatment plants in similar communities. After the question of a separate or combined sewer system is determined, the selection of the treatment required to meet local conditions is probably the most important question. Frequently the question of separate versus combined sewers is much complicated by the fact that the village already has in use a fairly complete storm-water system, laid largely in streets now paved. There are several interesting ways in which this problem has been solved, with the maximum of satisfaction possible at a reasonable cost. Such solutions, however, must always remain a makeshift substitute for the separate sanitary sewer system.

It cannot be expected that one kind of sewage treatment works will be suitable for all village installations. There is no one best type for all cases. The Imhoff tank, with or without secondary treatment, still has a place in sewage treatment for villages. Separate sludge digestion in combination with the sprinkling filter is much in use, and even activated sludge is being used in some village plants, although operating costs on this type are necessarily higher than on some of the other forms. A careful study of the quality and quantity of the sewage to be treated, the stream to receive the effluent, and the probable operation costs and difficulties must be given each case if the town is to receive full value.

If the young engineer enjoys variety in his work, enjoys discovering a new angle to an old problem or an entirely new problem, let him try helping various municipalities to solve their water and sewerage problems. But he must also be prepared for long hours of hard work, often with little appreciation, and certainly no overpayment for his services.

Sanitation Problems at Columbus

Survey Made of Silt Deposits in Water Supply Reservoir; New Incinerators Built for Refuse Disposal

AMONG the papers presented at the Columbus regional meeting of Local Sections on May 15, 1936, were two that dealt specifically with municipal sanitary engineering problems in Columbus—water supply and refuse disposal. The following articles are abstracts of the original presentations.

In the past several years reservoirs in many parts of the country have been drawn lower than ever before, and the receding water levels, disclosing large deposits of silt, have brought to the attention of the public a condition that has long been of interest to engineers. How rapidly is storage capacity being lost? What can be done about it? In the first article Mr. Edwards tells some of the results of a silt investigation made of the O'Shaughnessy Reservoir near Columbus, and describes the method of conducting the survey.

It is curious that the residents of any "modern" city should still accept inconvenient, or even unsanitary, methods of refuse disposal as a matter of course. Yet in many towns the housewives must carefully separate dry refuse from garbage, and papers from cans, and depend upon two or three separate agencies for refuse removal. And many an urban area is blighted by a nearby dump or odoriferous disposal plant. There are at present, however, some 700 municipal refuse incinerators in this country and in Canada. They have simplified the collecting of refuse, and operate without objectionable odors. Two of the most recent installations of this type are at Columbus. In the second article, Mr. Ramsey describes one of these plants in detail and points out its numerous advantages over the disposal system that it replaced.

Silting of the O'Shaughnessy Reservoir

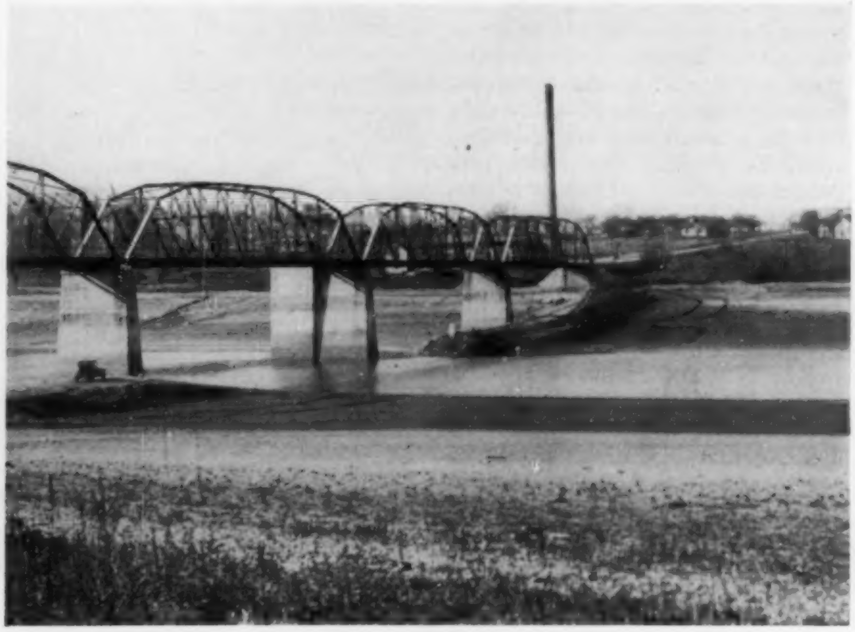
By A. M. Edwards

Assistant Engineer of Design and Construction, Division of Water, Columbus, Ohio

COLUMBUS obtains its water from two reservoirs on the Scioto River—the O'Shaughnessy, about 16 miles north of the city, and the Griggs, some 10 miles further downstream. In 1934 the discharge of the Scioto was the minimum of record. The total annual runoff of 2.12 in. from the drainage area above the O'Shaughnessy Reservoir was but 20.2 per cent of the average from 1922 to 1934, inclusive. For 298 consecutive days there was no flow over the spillway, and by December 3, 1934, the water was 36 ft below the crest.

This depletion of storage exposed a great expanse of silt. Already concerned over the possibility of a water shortage, the people of Columbus were further worried by this loss of storage capacity, and a silt survey project was initiated. The survey was carried out as an FERA project under the general supervision of C. E. Sherman, M. Am. Soc. C.E., professor of civil engineering at Ohio State University, and the field and office work were done by students of the same school. The city furnished transportation and certain equipment and materials.

Silt Deposits in O'Shaughnessy Reservoir Exposed by Low Water



O'Shaughnessy Reservoir, Three Miles Above the Dam, During the Drought of 1934

The low water level provided an unusual opportunity for an accurate survey. In the upper reaches of the reservoir, the water had receded to the original river channel, and the silt, after a few days' exposure to the sun, had caked so that it was possible to walk on it. In such areas, test holes were dug to determine the depth of the silt.

Where the silt was still under water, measurements were made from a boat equipped with a sounding reel of the type used by the U. S. Geological Survey in making stream-flow studies. Soundings were read to tenths of a foot. Two traverses were made of each cross-section—one to determine the original surface elevation of the channel, and the other, the surface elevation of the silt deposit.

For the first purpose a 1-in. steel rod, 42 in. long and pointed on the end, was attached to the reel. Its weight was sufficient to force it through the soft silt to the original river bed, which was of firmer material. For the second purpose, the rod was replaced by a wooden disk, 9 in. in diameter, weighted sufficiently to sink through the water but still light enough to be stopped by any slight obstruction. The rod and disk were equipped with swivel hooks so that they could be interchanged easily.

O'Shaughnessy Reservoir at crest elevation has a surface area of 829 acres. It is 8 miles long, 1,900 ft in maximum width, and has an average depth of 20 ft. The original capacity as determined by the silt survey was 16,673 acre-feet, and the volume of silt that had accumulated in nine years was found to be 1,016 acre-feet, or 6.1 per cent of that capacity. The deposit, spread evenly over the drainage area (988 sq miles) would be approximately 0.02 in. thick. Its specific gravity, based on an analysis of 12 samples, was 2.66.

The average annual rate of silting in O'Shaughnessy Reservoir is about 0.7 of 1 per cent of the original capacity. This compares with an annual rate of 0.8 of 1 per cent found for the Griggs Reservoir after 30 years of service. By contrast, silt surveys of several municipal water supply reservoirs in Texas have shown rates of from 2.0 to 2.4 per cent per year.

No immediate steps to provide additional capacity would seem to be necessary at Columbus. Additional storage of 1,200 million gallons in the O'Shaughnessy Reservoir and 500 million gallons in the Griggs Reservoir can be made available by the installation, on both dams, of flashboards 4 ft in height. If and when the existing storage becomes inadequate, it will probably be more economical to construct a new reservoir than to attempt to remove the deposit from the O'Shaughnessy Reservoir. This reservoir was built at a cost per million gallons of storage of about one-fifth that of removing an equal amount of silt.

Modern Refuse Incineration for Columbus

By EDWARD A. RAMSEY

DESIGNING ENGINEER, CITY OF COLUMBUS, OHIO

UNTIL the latter part of 1935, the City of Columbus disposed of its garbage by reduction, in a plant which had been put into operation in 1910. The collection system during this period was adjusted to conditions imposed by reduction, which meant that garbage was collected separately from other wastes and housewives were educated to keep all foreign matter out of it. Other combustible and all incombustible wastes were collected periodically by the municipality and hauled away to various city dumps. Coincidently, there developed a species of private scavenger who hauled away rubbish for a small sum and salvaged what he could. The usual nuisances attendant on such practices resulted at the dumps, including fires, smoke, and rats.

THE ARCHITECTURAL STYLE POPULARIZED AT THE CENTURY OF PROGRESS EXPOSITION WAS ADOPTED FOR THIS MODERN INCINERATOR

WHY INCINERATION WAS ADOPTED

The reduction plant was located about four miles south of the center of the city and connected by rail with a transfer station in an industrial district accessible from all four sections. Garbage was conveyed to the transfer station, loaded into railroad cars, and hauled to the plant. Grease was extracted and a low-grade fertilizer obtained.

In 1931 the city was confronted by the fact that, instead of producing an income or at least being self-supporting, its reduction plant was costing an excessive amount to operate and had become such a burden that some sort of action in regard to it was necessary. This state of affairs arose from several causes. First, although repairs were continuously being made, the time had arrived when it was imperative to replace some important items of equipment and make major changes in the buildings. Second, the cost of double handling, railroad haul, and maintenance of trackage was excessive, amounting to about $10,000 a year. Third, the market for tankage and fertilizer products had fallen off and showed no signs of recovery. And last, odors from the chimney were creating a nuisance in that section of the city nearest the plant, and there were many complaints. An investigation was started in the course of which incineration was discussed; several plants were visited; and this method was decided upon as more satisfactory and less costly than reduction.

DATA COLLECTED FOR DESIGN OF NEW PLANTS

Records of tonnage of garbage collected and percentage of variation during different months of the year had been kept over a period of 21 years. The peak daily tonnage for a 30-day period was 190

tons. Collection averaged 94 tons per day over the 12-year period between January 1922 and December 1933. No figures on the amount of rubbish produced were available, so it was assumed that the same conditions would apply in Columbus as in other American cities of the same size and type, and that a combined refuse composed of 65 per cent garbage and 35 per cent rubbish, by weight, could be counted on.

A study made of collection maps, and conditions and features peculiar to the city, resulted in the decision to build a 150-ton plant south of the center of town and a 100-ton plant in the north end. The dividing line between the two sections was set by railroad lines and yards running east and west through the city. Collection maps showed that 60 per cent of the total garbage was produced south of this line and 40 per cent north. It was felt that with a total capacity of 250 tons, the city could handle the peak conditions previously developed and easily care for unusual situations and normal growth for some time. The site selected for the south or, as it has come to be called, the Central Plant, was on city-owned property directly in front of the old transfer station and within one city block, each way, of the center of collection for the district. Since garbage trains had been daily handled near the site for a number of years, no objection was made to placing the plant there. The site originally selected for the north incinerator was in an industrial district, close to a railroad and within four blocks of the center of collection in that district. However, because there was a residential district across the tracks to the west of the site, a great deal of objection arose. The city officials finally abandoned this site and selected one on city property in an old stone quarry outside of and to the northwest of the town.

In the preparation of drawings and specifications, it was decided to confine the city's drawings to those for the buildings, to specify the equipment thoroughly,

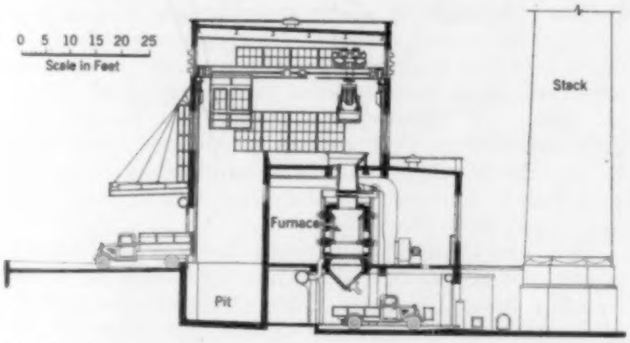
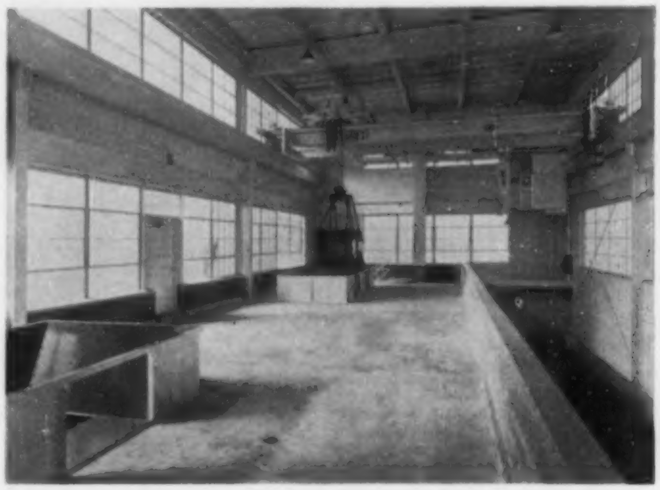


Fig. 1. Section Through Central Incinerating Plant, Columbus, Ohio

and to allow legitimate manufacturers to bid on their own furnace designs within the limits of the specifications and submit their drawings with their bids. This decision made the design of the buildings rather difficult since plan sections through the different furnaces varied widely. Information was procured from a number of manufacturers, who had several plants in operation, on the floor space required by their equipment. These data were assembled and the plans worked out so that any one of the four major types of top-feed furnaces could be built within their limits.

DESIGN OF CENTRAL PLANT

Refuse to be passed through incinerators is commonly handled in one of two ways. Either the material enters the building at a level above the furnace and is dumped direct or fed by hand into it, or it enters at a low level, is dumped into a bin, and is transferred by a crane and bucket to hoppers above the furnace. The site selected determines the method of handling. If the plant is built on a hillside, gravity feed is indicated but if it must be erected on a level site, the crane-and-bucket feed



Refuse, Brought to the Plant by Truck, Is Transferred by Clam-Shell Bucket from the Pit at the Right to the Hoppers

is preferable. The site selected for the Central Plant was practically level and sufficiently close to the Scioto River to prevent a deep basement. Consequently a crane-and-bin type of building was determined on (Fig. 1).

The building is 50 ft wide, 90 ft long, 45 ft high above the tipping platform, and has a basement 11 ft deep. It is of fireproof construction with the usual brick walls, steel skeleton, concrete floor and roof slabs, and steel factory sash. Inasmuch as there is no traditional style of architecture for this type of building, the contemporary, or so-called modern, style was used, inspired by buildings at the Century of Progress Exposition.

The chimney is 140 ft high. It is built of light radial brick on a concrete foundation. The outside diameter is 16 ft at the bottom and 11 ft 6 in. at the top. It is lined with fire-brick supported from top to bottom by a steel corset and has an inside diameter of 8 ft the entire height.

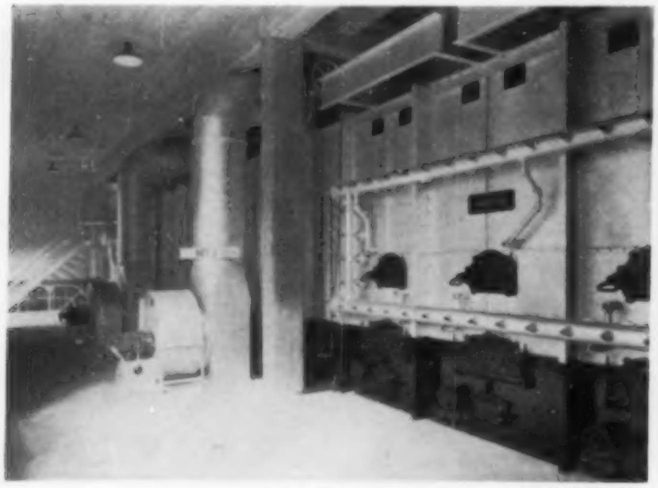
There are two furnaces with a capacity of 75 tons per 24 hours each, designed to incinerate a refuse composed of 70 per cent garbage and 30 per cent combustible rubbish, having a moisture content of 50 per cent. These are Decarie type, top feed, with receiving baskets built of pipe and water-cooled, and with cast-iron grates and water-cooled steel door linings. The walls are built of 9-in. refractory brick, backed up with $4^1/_2$ in. of insulating brick and cased with steel plates. The customary buck stays are provided. The roofs are of flat-arch construction, using refractory blocks supported from steel beams, and the whole is covered with steel plates.

OPERATING PROCEDURE

Mixed refuse is fed through the top of the furnace into the receiving basket, where it is dried and initial combustion started. From there it passes down onto the burning grates where it is burned to a fine, nuisance-free ash. The grates are so arranged that the entire surface may be dumped, and are operated from either side of the furnace at the stoking-floor level.

The ash pits below the furnace are provided with quenchers and dust- and waterproof gates, and are so arranged that the ashes can be dumped directly into trucks driven in below. The ashes are then hauled away to the city dump.

The gases of combustion pass the length of the furnaces and over bridge walls into combustion chambers which are similar to the furnaces in construction. From the combustion chambers the gases pass through preheaters to the flue. The preheaters are built of banks of refractory blocks with horizontal openings for the passage of gases and vertical openings for the passage of air. They are designed to heat the forced-draft air to temperatures ranging between 300 and 400 F. This type of preheater, while it heats up more slowly than the usual tubular type, has the advantage of being affected less by temperature changes of brief duration in the furnaces and maintains the forced-draft air at a more even temperature. It is believed that this type will be affected less by expansion and contraction and will outlast the metal-tube types. After leaving the preheaters, the gases pass through flues of the same construction as the combustion chambers to a single header flue and thence to the chimney. Dampers are provided in the flues for controlling the velocity of the gases, and traps are introduced throughout the system to collect fly ash before it reaches the chimney.

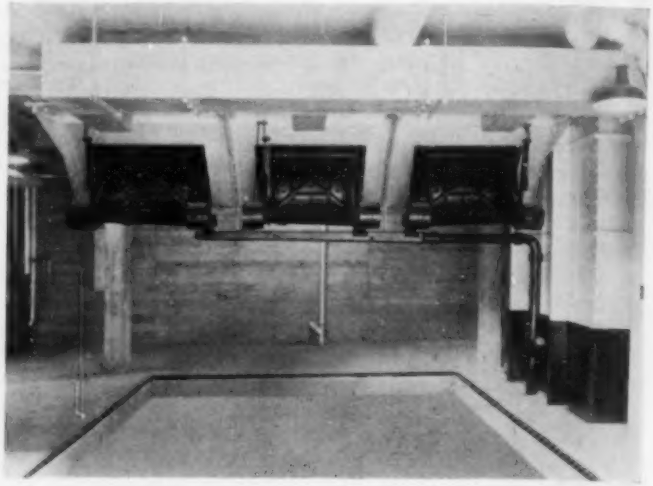


THE STOKING FLOOR
The Blowers in This View Pass Air to Preheaters Which Are Directly Beneath Them

Forced draft is required for the successful operation of refuse furnaces because of the great amount of air required to dry and burn a material with so high a moisture content. Air is collected from various parts of the building and passed through a fan for each furnace to the preheater, where its temperature is raised as previously mentioned, and thence into the furnace under the grates.

Recording pyrometers, one for each furnace, are located in the office, and indicating pyrometers in the stoking room. These instruments indicate the temperature of the gases in the combustion chambers and of the forced-draft air as it leaves the preheaters.

After the completion of the plant, tests were conducted by passing 75 tons of mixed refuse through each furnace. The mixture consisted of both wrapped and unwrapped garbage and combustible rubbish in the proportion of 70 per cent to 30 per cent, with a moisture content of 51 per cent. The average temperature in the combustion chambers during the test period was 1,496 F. When temperatures were high, no smoke was visible from the stack, and when there was some smoke it was light and practically colorless. No objectionable odors were detected either from the chimney or about the building. The average burning rate per square foot of grate surface per hour was 119.8 lb.



ASHES ARE CARRIED AWAY BY TRUCK
This View Shows the Hoppers and Gates Through Which They Are Dumped

The building was erected and the incinerators furnished and installed by the Decarie Incinerator Corporation of New York, N.Y., at a cost of $118,000.

SECOND PLANT NOW BEING BUILT

The second or West Plant on McKinley Avenue is now under construction. The site is in an abandoned stone quarry and the building is built against a bank. Refuse is brought in above the charging floor level and dumped onto the charging floor, whence it is fed by hand into the hoppers over the furnace. The flow of material, of preheated forced draft, and of gas is about the same as already described. The furnace, however, differs from that used at the Central Plant in that it is the Heenan type and has no pipe basket. Instead the material is delivered on a drying hearth back of the grates and stoked forward.

This plant will have a single furnace of 100-ton capacity per 24 hours and a chimney 100 ft high. The building is being constructed entirely of reinforced concrete and is 51 by 62 ft in plan and 51 ft high. It is expected to cost $78,000.

In the near future the city hopes to pass legislation which will make the draining and wrapping of garbage mandatory and will control the collection of combustible rubbish. It is felt that under the conditions effected by such legislation these plants will prove efficient and economical and the city will have a satisfactory refuse disposal system.

Drawings and specifications were prepared, and the work was supervised, by the Division of Engineering and Construction of the City of Columbus, under the direction of Paul W. Maetzel, chief engineer. John H. Gregory, M. Am. Soc. C.E., was consulting engineer. The work is being carried out as part of the city's PWA program, and all drawings, specifications, and contracts are subject to the approval of the Public Works Administration of Ohio and of L. A. Boulay, state director.

The Triborough Bridge Project

Construction of a Modern Metropolitan Traffic Artery

By E. Warren Bowden

Member American Society of Civil Engineers

Assistant to Chief Engineer, Triborough Bridge Authority, New York, N.Y.

Although provided with ideal natural waterway facilities, New York City has difficult problems to solve in its highway connections. The very conditions that make a perfect seaport impose severe handicaps on surface communications. Thus, while lower Manhattan has numerous bridges and tunnels connecting it with adjacent districts to the east and west, as well as bridges across the narrow Harlem River to the north, the upper Manhattan area has keenly felt the need of reaching across to the large and growing Borough of Queens on the east. Equally or more important, Queens and the Bronx have had no previous highway connection.

The Triborough project solves all these problems, joining together three districts formerly isolated by water. Its extent is in keeping with its importance. A length of three and one-half miles of main bridge structures and a cost of over $60,300,000 including connections—these inclusive data bear witness to the magnitude of the work described by Mr. Bowden.

Reference may be made to the article by J. C. Evans, engineer of approaches for the Triborough Bridge Authority, in the March 1936 issue, covering the extensive connecting highways that serve the Triborough Bridge. Consideration of the Harlem River lift span and the Bronx Kills crossing was purposely omitted from the present paper, as it will be covered by a separate article in a forthcoming issue.

Opened for traffic on July 11, 1936, the Triborough Bridge serves in a single structure the three New York City boroughs of Queens, Manhattan, and the Bronx. It is one of the most notable of the larger construction projects financed by federal funds through the agency of the Federal Emergency Administration of Public Works. With a total cost of over $60,000,000, the project is noteworthy for its magnitude. It is also of interest because of certain features of its design and the changes made from earlier designs. But undoubtedly the most important single consideration in connection with the Triborough Bridge is its utility as a traffic artery in overcoming difficult problems of vehicular movement in important sections of the metropolitan area.

The development of these sections has been retarded heretofore by the lack of adequate interborough vehicular facilities. Queens, to the east of Manhattan and to the south of the Bronx, is separated from both of those boroughs by the East River (Fig. 1). The Bronx and Manhattan are separated by the Harlem River, a narrow waterway connecting the Hudson and East rivers; and to serve them a number of narrow and congested bridges cross the Harlem River. But only one, the Queensborough Bridge at 59th Street, hopelessly overcrowded, has been available across the East River between Queens and Manhattan. Three other East River bridges at the south end of Manhattan Island connecting with Brooklyn are themselves carrying heavy traffic and so are of little avail in relieving conditions at the Queensborough Bridge. There has been no bridge at all between the Bronx and Queens, traffic having been forced to depend upon the comparatively limited services of the College Point ferry (eastern promontory of Flushing Bay, Fig. 1) or to detour via Manhattan and over the congested bridges just mentioned.

From the standpoint of saving in time or distance, or both, about 25,000,000 vehicles that crossed between the boroughs in 1935 would have found it advantageous to use the Triborough Bridge. This huge total of crossings was made in spite of comparatively inadequate facilities.

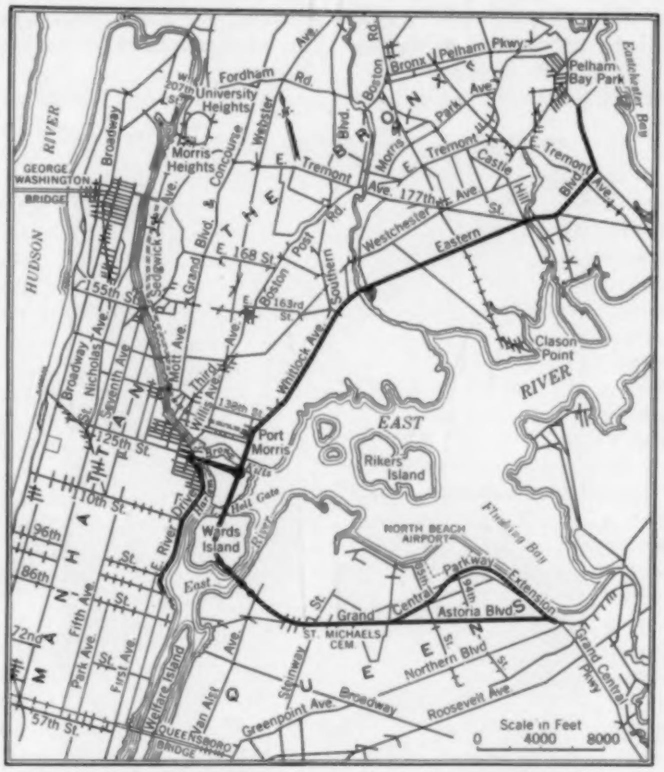


Fig. 1. A Part of New York City, Showing Location of Triborough Bridge and Its Connections

Utilizing a Natural Site

As will be noted from the map, Fig. 1, Wards Island and Randall's Island (immediately north of Wards Island) lie at the point of confluence of the Harlem and East rivers in such relation as to make an ideal site for a Y-shaped crossing. One of the first suggestions for a bridge to serve the three boroughs simultaneously by taking advantage of this site was made in 1916 by Edward A. Byrne, M. Am. Soc. C.E., then chief engineer of the Department of Plant and Structures of New York City. However, the project was not definitely studied in a serious way until 1925.

Construction was started in the fall of 1929 on what

PANORAMIC VIEW OF TRIBOROUGH BRIDGE AND CONNECTIONS; HELL GATE RAILROAD ARCH VISIBLE NEARBY

was to be a self-liquidating highway toll bridge to be financed by city corporate stock. Over a period of a little more than two years thereafter the city purchased land and engaged in construction at a total cost of about $5,400,000, building the tower foundations and anchorage cores for a suspension bridge to cross the East River and the foundation piers for a viaduct structure on Wards Island. In the spring of 1932, it was obliged to discontinue the project because of lack of funds.

Early in 1933 the project was transferred from the Department of Plant and Structures to the Triborough Bridge Authority. It was due largely to the efforts of Robert Moses, as chairman of the New York State Emergency Public Works Commission, and later as commissioner and chief executive officer of the Triborough Bridge Authority, that the original project was materially enlarged by the addition of many miles of highway connections in all three boroughs and their development as parkways and boulevards. On September 1, 1933, the federal government, through its Public Works Administration, executed a loan agreement with the Triborough Bridge Authority, under the terms of which a loan of up to $35,000,000 and a grant of 30 per cent of the cost of labor and material used on the project were made available.

In November 1933, a contract was awarded for the towers of the East River suspension bridge. Fabrication was actually under way when a complete reorganization of the Triborough Bridge Authority was made. Col. Paul Loeser was appointed director and O. H. Ammann, M. Am. Soc. C.E., chief engineer.

CHANGES IN PLANS REQUIRED

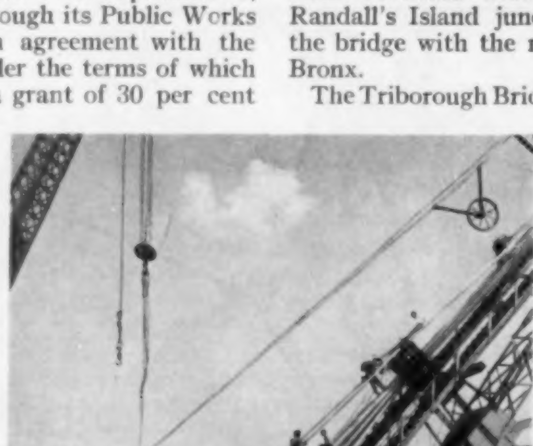
At the direction of the Authority, a complete review of all plans and cost estimates of the project was undertaken. These studies indicated that, on the basis of the plans current at that time, the bridge project without adequate provisions for connections would cost several million dollars more than the funds available. Accordingly, revisions in the design were undertaken which not only brought the cost of the bridge project within the funds available but, in addition, left a considerable margin for the construction of more adequate connections.

The original plans had contemplated the initial construction of a single deck structure, having two 36-ft roadways and providing for the later addition of an upper deck. Neither anticipated traffic nor the capacity of connecting highways warranted such ultimate capacity and the principal changes in the design had to do with the elimination of such provision. This materially simplified the plans, especially those for the East River suspension bridge. Two of the four cables and the two central columns of the towers were thus eliminated.

At the same time, plans for the viaduct structures on the Queens approach and over the islands were changed to eliminate the series of arches, partly granite-faced masonry and partly structural steel with heavy granite-faced piers, which were originally contemplated. Material revisions were also made in the plans for the Randall's Island junction of the Manhattan branch of the bridge with the roadways between Queens and the Bronx.

The Triborough Bridge project is divided into two principal parts: The bridge and approaches between terminals, that is, the bridge proper; and the arterial highway connections. The first division consists of a total length of $3^1/_2$ miles of structures, which provide two 4-lane roadways from Queens to the Bronx, and two 3-lane roadways on the Manhattan branch, in all cases separated by a wide center curb and flanked by sidewalks.

The most outstanding structure is the suspension bridge over the East River at Hell Gate, which has a main span of 1,380 ft. The deck is suspended at a clear height of 135 ft above water level from two parallel wire cables $20^3/_4$ in. in diameter. These are spaced 98 ft apart, and are supported by two 300-ft towers. The towers, which are of the cellular type, consist of two columns connected by bracing below the road,



PREPARING TO ADJUST FOUR STRANDS OF THE EAST CABLE, EAST RIVER SUSPENSION BRIDGE

way, at the roadway portal, and near the tower tops. Tower foundations on shore on either side of the river are on bedrock at a comparatively shallow depth and are of concrete, faced above ground with granite masonry. The anchorages are also founded on rock and have a width of 150 ft and a length of 225 ft.

The floor system is stiffened by trusses 20 ft deep so framed that the roadways are at about mid-height of the trusses. Walks for pedestrians are provided on either side, cantilevered out at the level of the top chord of the stiffening truss. The floor system is designed for a dead load averaging 19,200 lb per lin ft of bridge, a live load of 4,000 lb, and a wind load of 1,200 lb.

The junction on Randall's Island is a high-level structure designed to meet a twofold purpose. It serves as a medium for the interchange of traffic passing in either direction between any of the boroughs and between the island and the three boroughs, without grade crossings or left turns, and also for the collection of tolls. It is built entirely of reinforced concrete, with beams and slabs carried on columns with spread footings, the whole enclosed with concrete curtain walls.

The Harlem River is crossed by a through-truss vertical lift bridge with a 310-ft lift span over the channel, flanked by two spans of 152 ft 9 in. and 241 ft $9^1/_4$ in. on the Manhattan and Randall's Island sides, respectively. It provides a normal clearance of 55 ft over the water and a maximum clearance of 135 ft when the span is raised to its high position for the infrequent passage of high-masted vessels. The massive piers supporting the bridge towers are approximately 50 ft high and are founded on rock. The towers, which are pleasing in appearance because of their unusually substantial nature, reach a total height of 220 ft.

Over Wards Island, Little Hell Gate, and Randall's Island, between the East River suspension bridge and the junction, the viaduct structure consists of a series of deck plate-girder spans varying from 64 ft to 125 ft, the latter dimension being used in six spans over Little Hell Gate. Three lines of plate girders are supported on concrete piers of three shafts each. The Queens approach viaduct south of the anchorage, and the Manhattan branch from the junction to the Harlem River bridge, are of the same general type of construction.

North of the junction the roadways cross the Bronx Kills via a bridge of three through-truss spans, the central one being 350 ft in length. With the two shorter approach spans, the crossing totals 600 ft in length. It has a clearance of 50 ft above high water. Since the waterway is not now navigable, the crossing has been constructed as a fixed bridge with provision for future conversion of the channel span into a vertical lift span if the Kills should ever be made navigable. Four through-truss spans, from the Bronx Kills crossing to an abutment on the north side of 132d Street, continue the roadways of the Bronx approach over the Harlem River yard of the New York, New Haven, and Hartford Railroad Company. Initially, two 2-lane ramps are provided to ground level, and the central portion of the structure has been omitted, the design being such that a central ramp may be constructed later at a high level to join a westerly connection.

West of the Harlem River crossing, the Manhattan approach viaduct separates into two outside 3-lane ramps and a central ramp of two 3-lane roadways. The outside ramps descend to street level at Second Avenue at either side of 125th Street. The sidewalks from the Harlem River crossing flank these roadways and are also accessible by means of stairways at First Avenue. The central ramp which combines the on- and off-bound roadways to the East River drive curves around to the south in the area east of First Avenue, descending to street grade at approximately 122d Street. The viaduct structures are principally of plate girder construction on steel columns, terminating in ramps which are of concrete construction enclosed by curtain walls.

ARTERIAL HIGHWAY CONNECTIONS

So much for the general aspects of the bridge proper. The second division of the project embraces the 14 miles of arterial highway connections which have been either improved or constructed to facilitate the movement of bridge traffic in the three boroughs. These improvements are especially noteworthy because they indicate the advancement made in the conception of the essential unity of connecting highways and bridge structures with a common objective. In this case the connections account for 47 per cent of the total project cost. They were described in detail in an article by J. C. Evans, engineer of approaches of the Triborough Bridge Authority, in the March 1936 issue of CIVIL ENGINEERING.

ERECTING FLOOR STEEL, EAST RIVER SUSPENSION BRIDGE

FEATURES INVITE SPECIAL INTEREST

Although similar in its principal features to other bridges of its type, the suspension bridge over the East River has several points of special interest in connection with its design and construction. As previously mentioned, the bridge structure was redesigned. This took place after the fabrication of the towers had been started on the basis of the original four-column design, and was effected in such a way that the loss in time and materials was reduced to a minimum. On February 15, 1934, when the redesign was started, 1,800 tons of steel had been delivered to the fabricating shops, of which 1,200 tons were being fabricated for the pedestals. Work on the inside pair of columns was stopped but that on the outside columns was continued. All but 650 tons of the steel in the shops were used in the new design, and the entire 7,500 tons of steel for the towers and cable bents were fabricated and erected within the contract time as originally scheduled.

For erection the program was unusual and at the same time ideal from the standpoint of safety in that it permitted the separation of the operations of erecting and riveting. After erecting the Queens tower to the roadway level with a guy derrick supported on steel falsework, the derrick was dismantled and moved to the Wards Island pier for the same use. Following this, it

was returned to complete the Queens tower. Thereafter, it completed the Wards Island tower and finally the cable bents at the anchorages. Riveting thus proceeded on each tower during erection of the other tower without the hazards incidental to the progress of erection overhead.

Remarkable accuracy was obtained in the shop work on the tower material. The column sections were milled to length with such accuracy that it became unnecessary to follow the customary practice of making special corrections in the milled lengths of the top sections.

ERECTING SECOND-PASS STEELWORK, EAST RIVER CROSSING

In spinning the cables, the procedure was noteworthy only in that the equipment was considerably simplified. This permitted the strands to be spun in place in the cable saddles rather than in the more usual temporary supports on either side of the cable saddles. Each foot bridge was thus kept to a width of 7 ft, requiring only two steel wire ropes $2^1/_4$-in. in diameter for its support. Comparatively light equipment could be used at the tower tops because the strands did not need to be lifted into the saddles.

Strand formers of light-gage steel were used in the saddles to shape up the individual strands, and four strands were spun at one time. During spinning, these were held at their ends in such position as to raise the strand at mid-span a few inches in the clear above those previously completed, in order to allow free space for wire adjustment. When completed, the strands were easily adjusted through the saddles and at the anchorages. Thirty-seven strands, each with 248 cold-drawn galvanized steel wires of 0.196-in. diameter, comprise each cable, giving a net cable area of 277 sq in. At the allowable unit stress of 82,000 lb per sq in. (ultimate stress is over 230,000 lb per sq in.), the permissible maximum tension in each cable is about 22,700,000 lb.

When all strands were completed, the cables were compacted by hydraulic squeezers, cable bands were placed and footbridge sections were transferred from their own ropes to the cables. The footbridge ropes were then removed, cut to proper lengths for suspenders, and socketed and erected over the cable bands. The cable wrapping was deferred until after floor steel had been erected in order to allow for further adjustments in the cable wires which might affect the cross-sectional areas of the cables under load.

The floor steel was erected in two passes because of the excessive cable deflections which would have been caused by an attempt to erect it all at one time. In the first pass the posts, floor beams, lower chords, a few of the floor stringers, and the lateral bracing were placed. In general, the steel was erected by travelers working from the towers toward the center of the river in the main span and from the towers toward the anchorages in the side spans. All members were hoisted to the roadway level at the towers and transported over the panels previously completed. The remainder of the steel was erected during the return trip of the travelers toward the towers.

In Little Hell Gate, the piers for the viaduct were founded on the rock of the river bottom by means of circular steel cofferdams which were sealed against the rock by tremie concrete placed in an annular space between the outside steel and timber and an inside cylinder of timber sheeting on a collapsible frame. Both the inside sheeting and a layer of timber sheeting around the steel cofferdam were driven to contact with the irregular rock bottom. After the tremie concrete seal had been placed the cofferdam was unwatered, the inside timber sheeting removed, and the rock bottom inspected in the dry. A circular concrete pier base completely filling the space inside the tremie concrete seal was then brought to within 10 ft of high-water elevation. The concrete for these piers was placed by pumping.

CURVED ROADWAY OF MANHATTAN APPROACH LEADS TO EAST RIVER DRIVE

Floor steel for the Queens and Manhattan approach viaducts was erected entirely by caterpillar cranes operating on the ground. On Wards Island, over Little Hell Gate, and on Randall's Island, where the roadways are at a much greater height above the ground level, a stiff-leg derrick traveler was used.

In many respects the junction on Randall's Island is unusual. It has a roadway area of 390,000 sq ft—approximately nine acres—supported on over 1,700 concrete columns, and is faced on all sides by a concrete curtain wall having a total length of 8,000 ft. In all, over 70,000 cu yd of concrete and 5,900 tons of reinforcing steel (almost as much steel as is contained in the two towers of the suspension bridge across the East River) were used in its construction.

Tolls are collected in two areas—one on the roadways between Queens and the Bronx, providing for ten toll lanes, and the other, on the Manhattan branch, providing for twelve toll lanes. The paved width at the latter point is approximately 200 ft and gives space for two free lanes of vehicles passing from Randall's Island. At this junction the roadways have been arranged in such a way as to provide safe and easy divergence and convergence of traffic. Two of the roadways pass under the main structure between Queens and the Bronx.

The deck area is laid out in panels averaging 75 ft in length. Each is a complete self-contained unit sepa-

rated from adjacent panels by expansion joints over double columns. For construction purposes, the 4-in. concrete wearing surface was separated from the 7-in. structural slab.

In its structural design and in the use of welding to avoid a mass of detailed calculations, the Manhattan approach is somewhat out of the ordinary. It was desired to make each panel of the steel structure a self-contained unit and at the same time to avoid the usual types of diagonal bracing below the superstructure. Accordingly, double columns were required at each panel point. These consist of H-sections with parallel webs, connected by a diaphragm for a short distance above the footing. At their tops the columns are rigidly connected to the girders which frame into the webs. Each girder span is thus an individual rigid frame. The fixed connection to the girder at the top was necessary because of the unusual column height of as much as 50 ft. In erection, the girders were cambered for the full dead load in order to reduce column bending.

Welding was resorted to on the curved section of the steel superstructure leading to the East River drive, where superelevation, widening of roadways, grades, and curvature made it impossible to have any two members parallel either as to alignment or grade. The usual detailing of the connections between cross beams and stringers would otherwise have required a mass of calculations. It was only necessary to provide fillers of various sizes and shapes, which could be fitted under the beams as required in the field and then welded together.

ORGANIZING THE WORK

In a general article on a project of the magnitude of the Triborough Bridge, it is obviously impossible to do more than briefly mention a few of the many interesting features of design and construction. Certain features of unusual interest in connection with the Harlem River lift bridge and the Bronx Kills crossing have been omitted entirely since these will be treated in a separate article in CIVIL ENGINEERING by Enoch R. Needles, M. Am. Soc. C.E., member of the firm of Ash-Howard-Needles and Tammen, consultants who prepared the designs for these crossings for the Authority and supervised the erection.

However, the major problem successfully solved on this project has had to do with neither design nor methods of construction, but with creating the organization and planning the work. To make the preliminary designs, to prepare the contract drawings and specifications, to get the work under contract, and to have it completed in the very limited time available, was no mean task.

Over two thousand study and contract drawings were made in a period of about thirty months and, in addition, approximately nine thousand working drawings, made by contractors, were checked and approved. Although the Authority has employed as many as eighty-five men in its design engineering force and has also had the assistance of consultants on certain special features of the work, notably the Harlem River crossing, it would not have been able, unless aided by outside engineering organizations, to prepare all the plans required for the connections at the same time as the plans for the bridge proper. It was able to meet the construction program through the cooperation of the various city departments, the Long Island State Park Commission, and other public bodies, the engineering departments of which made the plans for those portions of the connections on which they were especially qualified by experience and information.

The work under the Triborough Bridge Authority has been divided into 65 contracts at a total cost of approximately $30,000,000. At one time, in the spring of 1936, during the peak of construction activity, 28 contracts, aggregating $21,000,000, were active simultaneously. The Authority supervised all this work of construction on both bridge and connections, employing up to 250 engineers and inspectors for the purpose. At the same time, a force of over seventy inspectors were engaged either full or part time in inspecting the manufacture of materials for the bridge in the mills and shops. At the time of opening, several of the contracts were still active on such parts of the work as are not essential to the operation of the bridge. These were not scheduled for completion at the opening date.

RANDALL'S ISLAND JUNCTION, SHOWING PROPOSED ARRANGEMENT OF RECREATION AREA NOW IN PROCESS OF IMPROVEMENT

ACKNOWLEDGMENTS

The chief engineer was assisted on the work by Edward W. Stearns, assistant chief engineer; Allston Dana, engineer of design; Col. H. W. Hudson, engineer of construction; J. C. Evans, engineer of approaches; Arthur I. Perry, principal assistant engineer; Aymar Embury II, architect; and the writer, assistant to the chief engineer. He also had the advice of Leon S. Moisseiff and Daniel E. Moran, consulting engineers, and Charles P. Berkey, consulting geologist. All of the above, with the exception of Mr. Evans and Mr. Perry, are members of the Society.

Plans for the Hudson River lift bridge and the Bronx Kills crossing were prepared by Ash-Howard-Needles and Tammen, consulting engineers. All shop and mill inspection is under the supervision of George L. Lucas, M. Am. Soc. C.E., engineer of inspection for the Port of New York Authority, all such inspection having been made by the latter organization by arrangement with the Triborough Bridge Authority.

All phases of the work were under the direct supervision of the Federal Emergency Administration of Public Works. During the early part of the construction, Arthur S. Tuttle, Past-President of the Society, and later Director, PWA, in charge of all work in New York State, served in the capacity of resident project engineer. He was succeeded in the latter office by Wharton Green.

Trends in Water Works Practice

New Chemicals, Equipment, and Methods Improve Quality of Public Supplies

By M. F. Trice

Assistant Engineer, State Board of Health, Raleigh, N.C.

During recent years a number of improvements have taken place in water works practice. Among these may be mentioned the use of newly introduced chemicals for better flocculation and elimination of tastes and odors, increased efficiency of sand filter beds due to higher rates of backwashing, and prolongation of chlorine disinfecting action through the addition of ammonia. Activated carbon has proven effective in removing taste-producing constituents of vegetable and animal origin. A mechanical aid to flocculation has been provided in the form of paddle wheels which rotate on a horizontal shaft, effecting a greater number of contacts between the coagulant and the suspended impurities. It has also been shown that a clean sand filter bed will produce a better effluent than the ripened filter previously favored in water purification plants. These and other recent advances are described in the accompanying article, which is abstracted from Mr. Trice's address made before the North Carolina Section of the Society at its 1935 spring meeting.

Discoveries made through intensive research, introduction of new chemicals, and experience gained in operating water supply systems, have in recent years brought about many changes in the design of water purification plants and in the chemical processes employed in them. As a result, several very definite trends in water works practice may be recognized.

The partial purification of water that is accomplished in the mixing chamber and subsidence basin is spoken of as preliminary treatment. It includes the addition of chemicals, mixing, floc formation, and sedimentation. Probably no phase of water works practice has been given more attention in recent years, which is not surprising, however, since approximately 85 per cent of the purification is accomplished in these units of the plant.

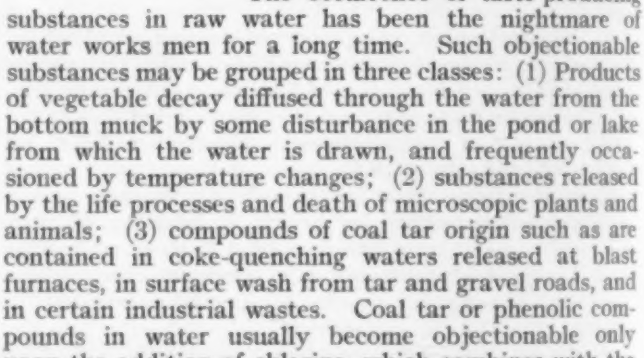
Prior to about 1925, the chemicals employed in water purification were limited to filter alum (aluminum sulfate) and an alkali, usually hydrated lime, although in some plants soda ash (sodium carbonate) and, more rarely, caustic soda were used. In a few isolated instances an iron salt was substituted for alum.

Aluminum sulfate does not cause complete flocculation of the colloids in some waters owing to the fact that it reacts efficiently only within rather narrow limits of acidity, and in some instances a poor floc results even within these limits. Moreover, waters that usually react with alum in a satisfactory manner will, at times during every year, change in character to such an extent that they no longer yield to its action, with the result that only partial clarification is accomplished. About ten years ago an aqueous solution of chlorine gas first was employed to improve the formation of the floc where a poor reaction was obtained with the alum and lime. Chlorine treatment so improved floc formation that at present its use for this purpose is widespread. The chlorine is added to the water at the head of the mixing chamber, prior to the introduction of the other chemicals.

Other compounds for use in the preliminary treatment have been introduced in recent years, as explained by L. L. Hedgepeth, in his article, "Coagulants Used in Water Purification and Why" (*Journal of the Sanitary Engineering Section, American Water Works Association*, Vol. 4, No. 1). One of these is sodium aluminate, which contains alum in combination with sodium hydroxide; thus the acidic and basic chemicals necessary to produce a floc are contained in one compound. This coagulant is useful in treating waters that are deficient in natural alkalinity, such as the colored ones of the Southeast. Chlorinated copperas (ferrous sulfate) was developed as a substitute for alum about eight years ago. Considering the amount of its active ingredients, it is cheaper than alum and its requirements for optimum floc formation are not confined to such narrow limits of acidity. Recently ferric sulfate has successfully replaced alum in at least two plants. It is of value where the concentration of manganese in the raw water is sufficient to cause trouble, for ferric sulfate will produce a floc in water that is sufficiently alkaline to precipitate manganese, while alum will produce a floc only in slightly acid water. Potassium permanganate has been used in a few instances for the removal of manganese and organic color.

Elimination of Taste and Odor Increasingly Effective

Whereas chemicals were formerly applied to water only for floc production, they are now employed for taste and odor elimination also. The occurrence of taste-producing substances in raw water has been the nightmare of water works men for a long time. Such objectionable substances may be grouped in three classes: (1) Products of vegetable decay diffused through the water from the bottom muck by some disturbance in the pond or lake from which the water is drawn, and frequently occasioned by temperature changes; (2) substances released by the life processes and death of microscopic plants and animals; (3) compounds of coal tar origin such as are contained in coke-quenching waters released at blast furnaces, in surface wash from tar and gravel roads, and in certain industrial wastes. Coal tar or phenolic compounds in water usually become objectionable only upon the addition of chlorine, which combines with the



Flocculator Installation at the Richmond, Va., Filtration Plant

phenol to produce chlorophenolic substances; these impart to the water a taste that may be described as medicinal. State health laws require disinfection with chlorine and for this reason the chemical cannot be omitted. Several chemicals have been introduced during the past few years that will remove, or prevent the formation of, taste-producing substances.

A chemical substance known as activated carbon will successfully remove from water the taste-producing constituents of vegetable and animal origin. The effectiveness of the carbon very probably is due to its great adsorptive properties. It is usually introduced in the mixing chamber along with the alum and alkali. The taste problem that accompanies the presence of phenolic substances has been solved recently by the use of liquid ammonia. This, when introduced into the water ahead of the chlorine, prevents the formation of chlorophenolic compounds. The use of ammonia subsequent to chlorination has little or no effect in this respect.

In addition to alum and an alkali, most plants now use one or more of the taste-removing, or taste-preventing chemicals as routine practice. While exact figures are not at hand, it is probably safe to say that at present more than 200 plants in the United States alone are using activated carbon in addition to alum and lime in the treatment of water. Besides removing taste-producing substances, it has been found to improve the quality of the floc, to give the water "brightness" and sparkle, and during warm weather, to stabilize or prevent the fermentation of impurities that have settled out in the subsidence basin. Prechlorination, either alone or with ammonia, is now widely used.

FUNCTIONS OF MIXING CHAMBER AND SUBSIDENCE BASIN

The chemicals which are added to the water in the mixing chamber react with one another and with other constituents naturally present, producing insoluble compounds which form slowly into millions of small particles known as floc. The floc, because of its gelatinous nature, collects particles of suspended mineral matter and bacteria as it moves through the water. Furthermore, the processing chemicals, being electrolytes, destroy the mineral and vegetable colloids and make them amenable to the action of the floc. The function of the mixing chamber is to distribute the chemicals evenly and to set up a rolling motion that will cause the floc to sweep through the water and so collect the suspended impurities.

The conventional over-and-under baffle mixing chamber is assumed to accomplish this by the proper spacing of the baffles. Since the chemicals are introduced at the head of the mixing chamber, the baffles in the first half are placed relatively close together to increase the velocity of the water and to thoroughly mix all ingredients by the churning action that results. Near the end of the chamber the baffles are spaced farther apart, with the result that the velocity is decreased and a rolling movement is produced. This action increases the size of the floc by increasing the number of its contacts with the suspended material. It is readily seen that such an agglomerating movement of the water is essential to efficient pretreatment, since the required degree of clarification can be obtained by the sedimentation which follows only through the production of floc particles of sufficient density to settle readily. For a long time water works men have been aware of the fact that the mixing chamber often fails to condition the water properly, with the result that poor clarification is obtained in the subsidence basin. This difficulty is a constant problem at some plants, while at others it is seasonal. Many operators have attempted to solve it by improving the action of the mixing chamber through the use of chemicals other than alum and lime.

BEAUTY IS NOT INCOMPATIBLE WITH UTILITY
A 300,000-Gal Water Tank at Towson, Md.

A MECHANICAL AID TO FLOCCULATION

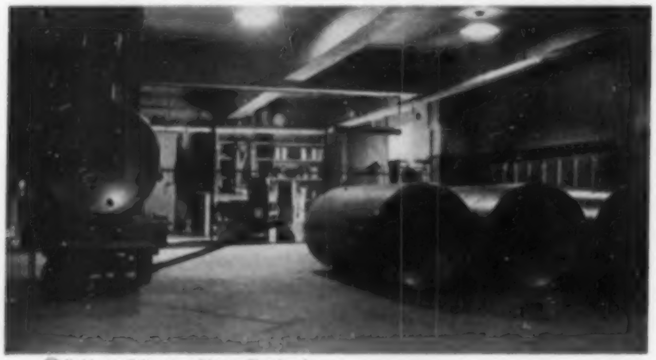
It remained for a Southerner to attack the problem from a mechanical or physical aspect. At Richmond, in 1932, Marsden Smith conceived the idea that it was as necessary to bring the chemically formed floc into contact with all particles of suspended matter as it was to form the floc in the first place, and that many mixing chambers failed in this respect. Consequently, he confined his study of the problem primarily to varying the period of floc contact with the water. His research culminated in the discovery that prolonged agitation of the water resulted in the formation of larger particles of floc, so that better clarification was obtained upon subsidence. The prolonged period of mixing increased the number of contacts of the suspended matter and resulted in the development of flocculent masses of greater size and density.

The device for increasing the period of agitation, called a flocculator, consists of paddle wheels mounted on a horizontal shaft. Thus far they have been installed in the inlet end of subsidence basins, but the construction of special chambers for them is anticipated. Their use at the Richmond plant has resulted in a marked improvement in the clarification of the water and, it is thought, has reduced the quantity of chemicals required for satisfactory floc production. Widespread use of this innovation is predicted. It is probable that improved flocculation will result in a decrease in the detention time for subsidence basins, which at present varies from four to

six hours. Such a development would reduce construction costs.

SOME PROBLEMS ENCOUNTERED WITH SAND FILTERS

After treatment in the mixing chamber and partial clarification in the subsidence basin, the water is filtered through sand to remove the remaining bacteria and any residual turbidity. Sand filters are responsible for much of the grief experienced by the operators of water plants. The filter problems include the development of mud balls and hard spots in the bed, coating of the sand grains with organic matter and calcareous deposits, development of cracks in the sand surface, shrinkage of the sand from the walls of the filter box, and unequal distribution of the wash water.



© Baldwin Filtration Plant, Cleveland

ONE-TON LIQUID CHLORINE TANKS ARE REPLACING THE 150-LB CYLINDERS

Periodic washing of the sand by water forced up through the bottom of the filter box is intended to remove collected impurities, but in many instances it fails to accomplish this purpose and the difficulties enumerated result. The problems are widespread and may be found in plants that are under technical supervision as well as in those operated by less efficient personnel.

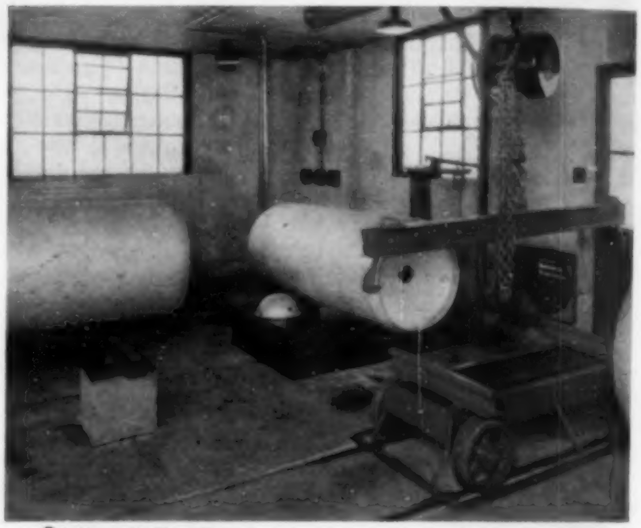
The study of the problem of filter-bed operation and maintenance during the past five years has caused many notions inherited from the days of slow sand filtration to be discarded. It has been demonstrated that it is not necessary for a bed to ripen, that is, to develop a slime coating on the sand grains, in order that the filter may function properly. Indeed it is now known that a scrupulously clean sand will produce a cleaner effluent. Clean beds are free from such evils as mud balls, cracking, shrinking, and odors, which were regarded as necessary evils not so long ago.

THE TREND TOWARD HIGHER BACKWASH RATES

In backwashing, the conventional rate of 1-in. rise of wash water per minute for each inch of freeboard has been standard practice for a generation. Since engineers have favored a 24-in. freeboard, the standard wash rate has been a 24-in. rise per minute. This velocity has been used day in and day out, winter and summer, for years, apparently with little thought as to whether it was adequate to clean the sand at all seasons. In recent years filter-bed difficulties have been eliminated at many plants through an increase in this rate ("Hydraulics of Rapid Filter Sand," by Roberts Hulbert and Douglas Feben, *Journal of the American Water Works Association*, vol. 25, No. 1, 1933).

The plant serving Cleveland, which reported good conditions, washes at 24.6 in. per min in mid-winter and gradually increases the rate to 36 in. per min in mid-summer. At Mt. Clemmons the formation of mud balls was checked by raising the wash-water troughs and using a higher sand expansion. It is significant that Flint, which reported good conditions in winter and bad in summer, washes at the rate of 18 to 20 in. per min throughout the year.

Roberts W. Hulburt and Frank W. Herring, working at Detroit, reported that two filters which had developed most of the objectionable characteristics mentioned were cleaned thoroughly and put into service as experimental units. Increased wash-water facilities made it possible to raise the rate of washing to 43-in. of vertical rise per minute. This caused a sand expansion of 16.3 in. or 60 per cent of the thickness of the bed, and eliminated difficulties enumerated. From this time on, the two filters never again showed any tendency to become muddy, to collect mud balls, or to show shrinkage cracks, and the sand remained free from coating. When the operation of the plant was discontinued, the coating on the top $^1/_2$-in. layer of sand amounted to only 1.5 per cent. Furthermore, during the washing process the rising wash water cleared within two minutes to such an extent that the suspended sand surface could be seen plainly through it.



© Indianapolis Water Company

EQUIPMENT FOR HANDLING LARGE CHLORINE TANKS

In an attempt to eliminate some of the objectionable conditions that filters are heir to, anthracite coal has been used with fairly satisfactory results at several plants. Its use is based partly on the fact that its specific gravity is lower than that of sand. Consequently, it expands the required amount with a lower rate of wash than is necessary with sand. This is an important factor since in many plants an increase in the velocity of the wash water cannot be obtained without the expenditure of a considerable sum.

VELOCITY OF WASH WATER VERSUS EXPANSION OF SAND BED

In the opinion of many investigators, the expansion of the sand bed and not the velocity of the wash water should be used as a guide in filter washing. Hulburt and Herring state that at Detroit an expansion of 35 per cent apparently fails to keep the sand clean throughout the year, and that it is doubtful whether 40 per cent would do it. In their opinion some percentage between 40 and 45 is the minimum for satisfactory results. Roberts Hulburt also states that in many new plants—notably Warren, Ohio; Ft. Wayne, Ind.; Springfield, Ill.; Spring-

wells, Detroit, Mich.—increased rates of backwash are being provided sufficient to yield a sand-bed expansion of at least 50 per cent under summer conditions (low-viscosity water). This usually requires higher wash-water pressures, larger piping and troughs, and placing of the troughs well above the sand surface (higher freeboard). Furthermore, he says that the results of high-expansion washing have been highly satisfactory at Springwells, Detroit; Mt. Clemens, Mich.; and Cleveland, Ohio.

Various expedients have been devised to distribute wash water evenly through the sand bed. The latest is a porous plate of strong, inert, fused, crystalline alumina. The use of such plates in the construction of a false filter-box bottom makes it unnecessary to employ a bed of graded gravel for the support of the sand, since the latter may be placed directly upon the porous plate structure. The manufacturers claim that such a filter bottom has advantages over other types in that it is not subject to corrosion, and the distribution of both filtrate and wash water is 100 per cent over the entire area of the bed.

THE NEW AND THE OLD AT THOMASVILLE, N.C.
A 1,000,000-Gal Tank Replacing Another of 75,000 Gal

THE AMMONIA CHLORINE DISINFECTING TREATMENT

After filtration, most states require disinfection as a factor of safety to insure that no live pathogenic organisms reach the consumer. The most recent development for the destruction of bacteria is the use of ammonia in connection with chlorine. The introduction of ammonia ahead of the chlorine prevents the rapid dissipation of the latter and causes its sterilizing action to persist for a week under certain conditions. In addition, this method has been found to prevent many of the changes in quality that take place in a distribution system, with the result that a more palatable water is delivered to the consumer. This is especially noticeable in sections served by dead ends.

The one serious objection to the use of ammonia in conjunction with chlorine is that about two hours are required for complete disinfection, whereas with chlorine alone the action is almost instantaneous. Where the water is to be held in storage two hours or more before delivery to the first customer, dependence may be placed upon this treatment to effect complete disinfection.

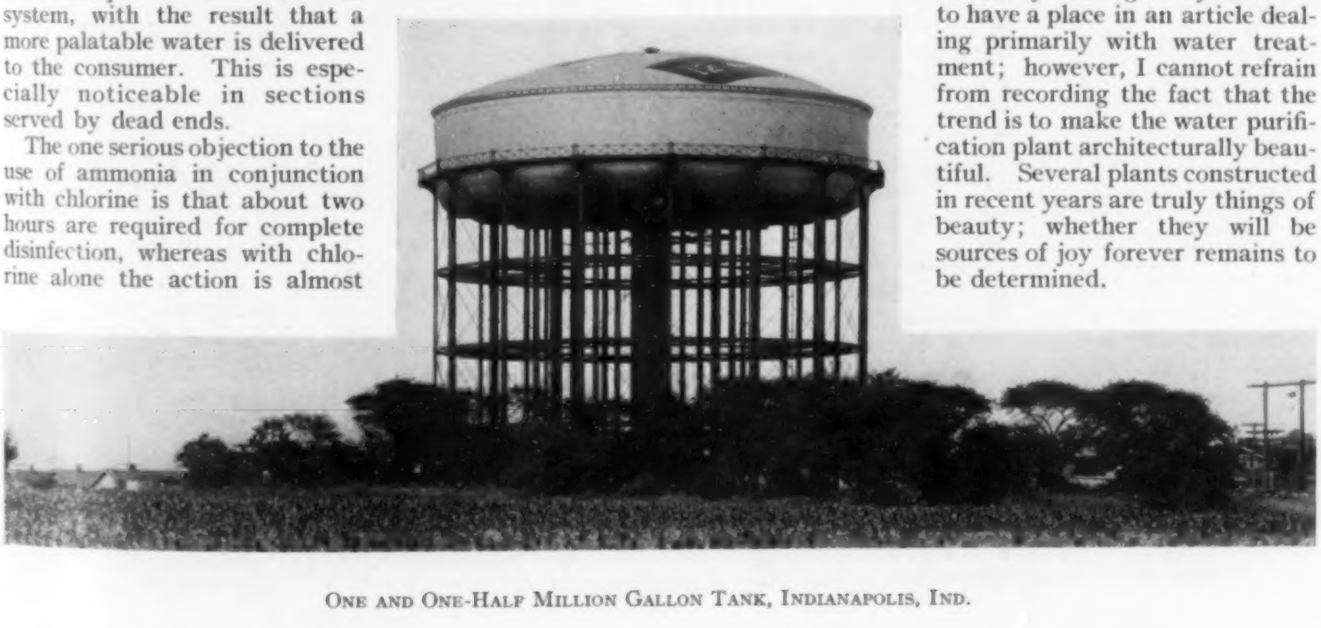
In many instances the use of the ammonia-chlorine treatment is based entirely upon the desire of the officials of the water works to make the water more palatable; one of the present trends in water works practice is the production of a water that is more acceptable and attractive for domestic use. It is not enough that it be free of perceptible turbidity; it must sparkle, be free from the slightest odor or taste, and have a hardness not exceeding 75 ppm (about $4^1/_2$ grains). Hardness does not mean much in North Carolina, but in some states of the Middle West raw water often has a hardness of approximately 400 ppm. Removing four-fifths of the hardness of such water renders it quite acceptable for domestic use.

Additional evidence that the public, more than ever before, is demanding an attractive water lies in the increase of municipal iron-removal plants during the past few years. The presence of dissolved iron in excess of 0.2 ppm makes water unsuitable for many domestic uses.

TRENDS IN STORAGE AND PLANT DESIGN

While the subject of storage perhaps should not be included in a discussion of water purification processes, it would occupy an important place in any treatise on water works practice. In this connection the trend is toward the use of elevated, rather than ground storage. It costs very little to elevate the reserve supply, and once in the air it is always ready for use.

Beauty of design may not seem to have a place in an article dealing primarily with water treatment; however, I cannot refrain from recording the fact that the trend is to make the water purification plant architecturally beautiful. Several plants constructed in recent years are truly things of beauty; whether they will be sources of joy forever remains to be determined.



ONE AND ONE-HALF MILLION GALLON TANK, INDIANAPOLIS, IND.

Dublin Bridge and Grade Separation

Stone Facing Gives Pleasing Appearance to New Ohio State Highway Structure

By D. H. Overman

Designing Engineer of Bridges, Ohio State Highway Department, Columbus, Ohio

Fitting a major highway crossing to its traffic requirements and scenic surroundings has been successfully accomplished in the Dublin Bridge over the Scioto River, 13 miles north of Columbus. Partial separation of traffic has been attained quite economically so that the worst condition of congestion is avoided until such time as more expensive and complete measures are warranted. A stone facing of local limestone was adopted to serve two purposes; it made the bridge blend well with its setting, and by its inherent beauty it rendered still more pleasing an already attractive structure. The basis for these developments and the means by which they were effected are disclosed in this interesting account abstracted from Mr. Overman's paper delivered at a regional meeting of Society Local Sections at Columbus, Ohio, on May 15, 1936.

Some interesting factors controlled the general design and detailed features of the bridge over the Scioto River, opened on January 3, 1936. As shown in the accompanying view, it is a six-span arch structure of reinforced concrete, faced with Columbus limestone.

At this point, near the village of Dublin, Ohio, 13 miles north of Columbus, an old bridge carried Ohio Routes 31 and 161 over the river (Fig. 1). It consisted of three 138-ft half-through trusses, and was weak and narrow as well as poorly aligned.

Another difficult problem that pressed for solution concerned the disposition of an intersection immediately to the east. The heaviest traffic on week days is over Route 31, which follows the east side of the river, going north from Columbus, and turns west over the bridge. On Sundays and holidays, however, it continues north along the east side of the river to the O'Shaughnessy Dam and city zoo instead of crossing the bridge. Traffic is generally light on Route 161, the east-and-west road, although it is expected that some day it may be relatively more important.

Consideration was given to the full separation of grades at this intersection but it was finally decided to make only a partial separation now, designing the new bridge and approaches so that a more complete separation could be constructed in future should traffic demand it. Hence the grade was raised about 6 ft and southbound through traffic was diverted under the east span of the new bridge (Fig. 1). This eliminates the interference of the heavy southbound holiday traffic with that passing over the bridge. The raising of the grade line also permitted the east and west approach gradients to be reduced from 9 to 4 per cent.

Of the six arch spans of three ribs each, the two central ones are 100 ft from center to center of piers, the intermediate ones 95 ft, and the two end ones, which are unsymmetrical, 73 ft. The bridge has an overall length of 627 ft and carries a 32-ft roadway and two 3.5-ft sidewalks. Floor beams and columns were designed as rigid frames. The 1.5 per cent gradient over the bridge required a somewhat different shape for each arch, since the floor system was made a constant depth at the center of all spans.

Solid spandrel walls, in addition to the columns, were placed on the outside ribs. The exterior surfaces were faced with stone in an effort to produce a structure of pleasing appearance which would harmonize with its natural surroundings. Most of the land bordering the river has been developed into a parkway, since the river serves as the water supply for the city of Columbus. Limestone of the same formation as that quarried for facing stone and concrete aggregates, outcrops along the banks of the river for many miles above and below the bridge. This stone has been extensively used for building purposes, some of the oldest as well as the most modern homes in Columbus having been constructed of it.

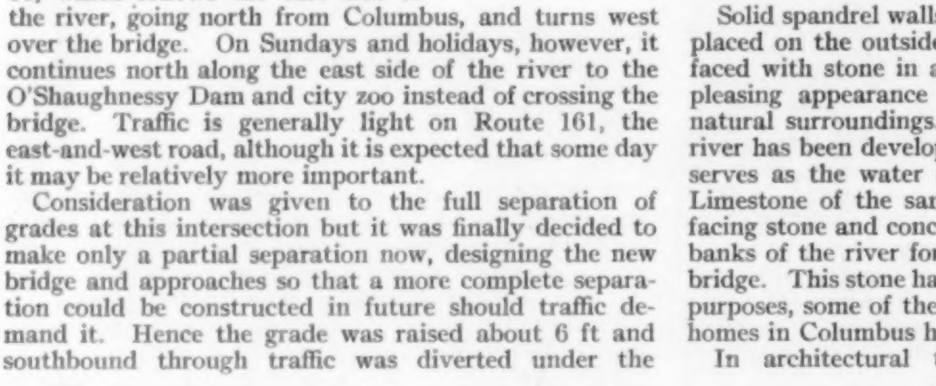


Fig. 1. Plan View of New Dublin Bridge
Skew Alignment Fits Into Favorable Highway Adjustments at East End

In architectural treatment the overhanging balconies and vertical wall recesses, of unequal length and spacing, add a touch of ornamentation and serve to break up the flatness of the large wall areas by casting shadows over the surfaces of the stone. The facing stone was laid random ashlar with 1-in. rock faces and $^3/_4$-in. mortar joints, raked to a depth of $^3/_8$-in. Considerable care and experience are required to produce a pleasing combination of sizes and colors. No predetermined pattern was followed although the plans specified the limits in course heights and face areas. The color in Columbus limestone is obtained by laying some of the stones with their natural bedding planes exposed. Such stones are known locally as "shiners" and show a wide range of coloring, generally tans and browns, due to vegetable and

mineral stains. The trim stones on the piers and the cap stones on the railing were bush-hammered to definite planes and laid with $^1/_2$-in. flush joints to give the bridge a more finished appearance.

Limestone sand was used instead of natural sand in the 1:2$^1/_2$ cement mortar, which contained 10 per cent of hydrated lime. This mortar, although somewhat unusual, developed a high strength and had good workability.

EAST END OF BRIDGE WITH ARCH UTILIZED FOR SOUTHBOUND TRAFFIC
Wire Road Guard to Be Replaced with Old-Style Stone Fence Common to This Locality

ANCHORING STONE TO CONCRETE

Facing stone on piers and arch ribs was placed first, after which the concrete was placed in direct contact with the stone. Each stone of the arch ring was anchored to the concrete with two $^3/_4$-in. galvanized steel bars embedded in the mortar joints with hooked ends engaging holes in the stones. The ring stones were further anchored by using alternate units of 8$^1/_2$ and 14-in. thickness. The pier stones varied in thickness from 8 to 12 in., and one No. 4 galvanized wire anchor was embedded in each horizontal joint for each stone.

All other stone facing was anchored to the bridge, after the concrete was placed, by means of continuous strips of 4 by 4-in. welded mesh projecting from the center of vertical anchor grooves placed in the concrete on 18-in. centers. These strips provided an adjustable connection for the hooked anchors which were embedded in the mortar joints. Both anchors and mesh were made of No. 4 galvanized wire, and one anchor was provided in each horizontal joint for each stone. Shear resistance between the facing stone and wall concrete was developed by horizontal grooves spaced on 18-in. centers between the vertical grooves. The total thickness of the facing, including stone and mortar, was 7 in. The stone was allowed to vary from 5 to 6$^3/_4$ in., but all voids between the stone and the concrete were completely filled with mortar.

DUBLIN BRIDGE OVER THE SCIOTO RIVER
Graceful Lines and Decorative Stone Trim Make a Handsome Structure

CONSTRUCTION DETAILS ARE OF INTEREST

Steel centers were used in the construction of the four central arch spans and wood centers for the two unsymmetrical end spans. The centers were erected for one complete line of six ribs and moved sideways from one rib to another by means of rollers.

Arch ribs were placed in five sections, in the usual manner, after the arch stones were in place. No concreting was permitted in an arch rib until the arch ring stones had been placed in the adjoining spans at least five days. This specification was intended to keep the stonework well ahead of the concreting and to allow some time for the mortar joints to cure before they were subjected to construction stresses. To relieve initial stresses in the arch stones, due to deflection and shrinkage in the concrete, open joints, with wedges, were left at designated points. These open joints were carefully filled with mortar immediately before the abutting concrete was placed. Lead wedges were used on the back face of the stone and left in place. The wood wedges used on the outside face were removed just before the mortar joints took their initial set. All exposed surfaces, except those within 5 ft of the bottom of the deck slab, were sand blasted after the concrete was at least three weeks old to give a color and texture similar to that of the facing stone.

A sprinkler system was effectively used in curing most of the concrete and stonework, the remainder, except roadway slab, being cured with wet burlap. The roadway slab, which was to be covered with a hot bituminous surface course, was cured with asphalt emulsion instead of water.

For the bridge alone, the contract price was $198,723. The extra cost of the stone facing cannot be definitely determined since a substantial allowance for the cheaper forms and the elimination of surface finish must be deducted. The additional cost would generally be from 8 to 10 per cent. It is felt that the extra protection offered by the stone and the improved appearance are well worth the added cost on this particular bridge.

When the Dublin Bridge was opened to traffic on January 3, 1936, some work, such as sand blasting, landscaping, and construction of permanent stone guard rails had not yet been completed. The bridge was designed by the Bureau of Bridges of the Ohio State Highway Department and constructed by the department using federal and county funds.

ENGINEERS' NOTEBOOK

From everyday experience engineers gather a store of knowledge on which they depend for growth as individuals and as a profession. This department, designed to contain ingenious suggestions and practical data from engineers both young and old, should prove helpful in the solution of many troublesome problems.

Thicker Bearing Plates Required for Thin-Flanged Beams

By PHILIP G. RANSONE

STRUCTURAL ENGINEER, BOARD OF PUBLIC EDUCATION, PITTSBURGH, PA.

IN structural steel handbooks the required thickness of a steel bearing plate under a beam supported by a masonry wall, Fig. 1, is usually given by an equation equivalent to the following:

$$t = \sqrt{\frac{3\,w\,B\,(B - b)}{4\,f}} \quad \ldots\ldots\ldots\ldots [1]$$

in which t = thickness of bearing plate, in inches
B = width of bearing plate, in inches
b = flange width of beam, in inches
w = average pressure of bearing plate on masonry, in pounds per square inch
f = allowable fiber stress in bearing plate, in pounds per square inch.

Such equations assume that the beam flange is stiff enough to distribute the reaction uniformly to the bearing plate. For the old standard I-beam with its narrow beveled flange, such an assumption is sufficiently accurate. However, the wide-flanged beams now in general use have flanges that usually are too thin and too wide to distribute the reaction uniformly. As a result, the thickness of the beam flange should be taken into consideration in designing the bearing plate.

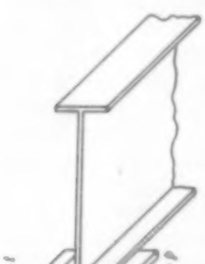


FIG. 1. BEAM AND BEARING PLATE

The maximum bending stresses in the plate and flange occur under the edge of the beam web (ignoring the fillet). If the thickness of the beam web is neglected—that is, if it is assumed that the reaction is applied to the flange and plate on the center line of the beam, the bending moment per unit of length to be resisted by the flange and plate combined is

$$M = \frac{w\,B^2}{8} \quad \ldots\ldots\ldots\ldots\ldots\ldots [2]$$

If this moment is resisted by flange and plate in proportion to their respective moments of inertia, the fiber stress in each will be in proportion to its thickness. Then the combined resisting moment of the flange and plate will be

$$M = f\,\frac{t^2}{6} + f\,\frac{p}{t}\,\frac{p^2}{6} = \frac{f}{6}\left(\frac{t^3 + p^3}{t}\right) \quad \ldots\ldots [3]$$

where p is the thickness of flange at the web of the beam, and t and f are as previously given.

In the graph, Fig. 2, the bending moments as given by Eq. 2 for several widths of bearing plates have been plotted for the usual range of bearing pressures. To the same vertical scale the combined resisting moments of various flange thicknesses and plate thicknesses as given by Eq. 3 have also been plotted. The maximum allowable fiber stress, f, has been taken as 18,000 lb per sq in. From this graph the required thickness of a bearing plate can be readily taken.

For example, assume a 16-in., 36-lb beam, a reaction of 32.0 kips, and a 12 by 12-in. bearing plate. The beam flange is $^7/_{16}$-in. thick, and the average pressure under the plate, w, is 222 lb per sq in. From Fig. 2, as indicated by the dotted lines, the thickness of plate required is $1^1/_8$ in.

The required thickness as determined by Eq. 1 would be $^3/_4$ in. But with such a design, if the moment of the

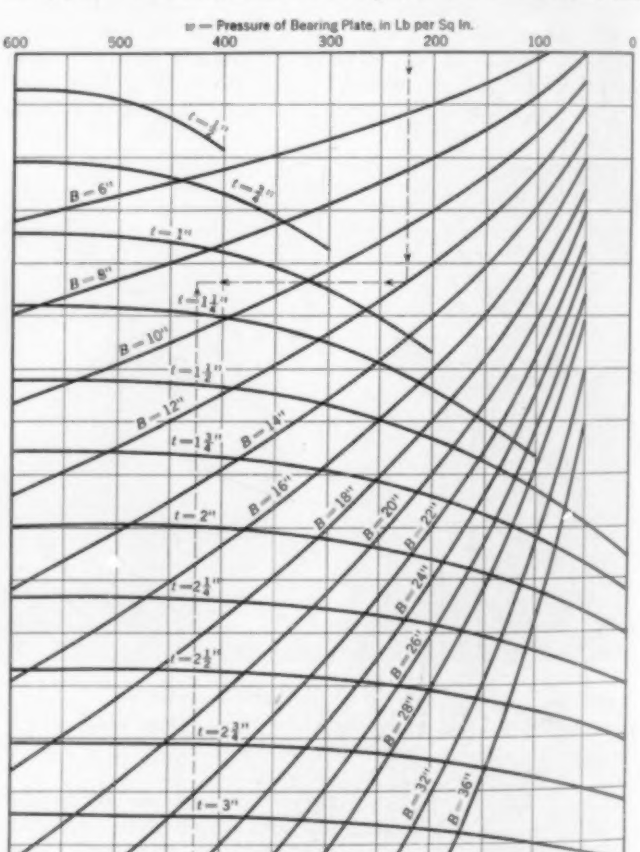


FIG. 2. REQUIRED THICKNESS OF BEARING PLATES, TAKING INTO ACCOUNT THE THICKNESS OF THE BEAM FLANGE

Based on a Maximum Fiber Stress of 18,000 Lb per Sq In.

reaction is resisted by the flange and plate in proportion to their moments of inertia, the stress in the flange under the edge of the web (ignoring the fillet) is 19,500 lb per sq in. and the stress in the $^3/_4$-in. bearing plate is 34,200 lb per sq in. If it were possible to distribute the reaction uniformly to the bearing plate, as is assumed in Eq. 1, the stress in the flange would be 70,000 lb per sq in. These stresses would be reduced to some extent, of course, by the stiffening effect of that part of the beam flange not over the support.

When a beam with a narrow and thick flange is used with a very wide bearing plate, Eq. 1 may give a plate that is thicker than that indicated by Fig. 2. However, with the wide flange beams now in general use, Fig. 2 will usually determine the thickness of bearing plate required.

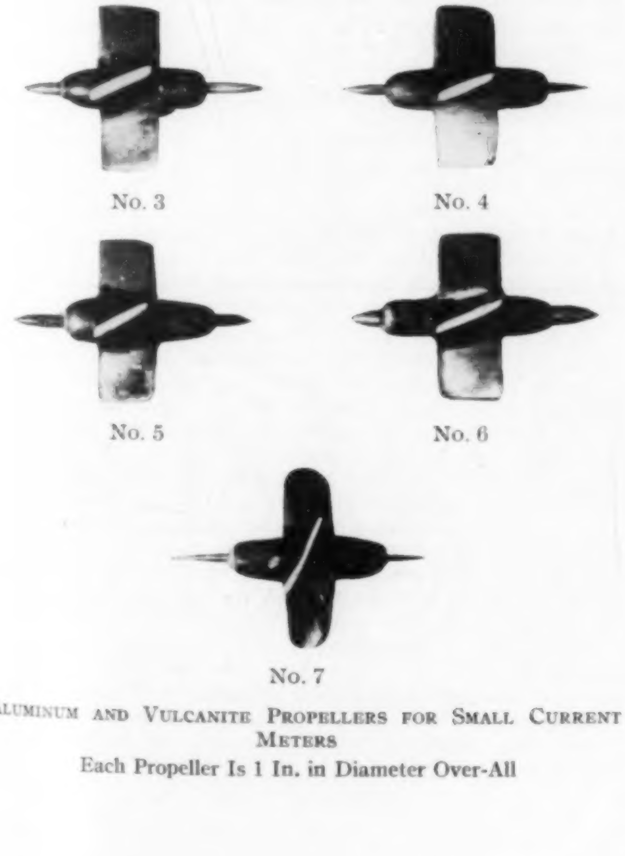
Small Current Meters for Hydraulic Models

By Nolan Page, Jun. Am. Soc. C.E.

Assistant Engineer, U. S. Engineer Sub-Office Hydraulic Laboratory, Iowa City, Iowa

In the course of tests made on hydraulic models by the U. S. Engineer Department staff at the Iowa Institute of Hydraulic Research it is necessary, at times, to determine subsurface velocities in the shallow streams of river models. An instrument suitable for this purpose must register velocities as low as 0.1 ft per sec and operate in depths of 0.1 ft or less.

Pitot tubes with differential-liquid and inclined manometers were first tried, but were found not to be sufficiently accurate at the lower velocities, so attention was turned to the development of other methods. In November 1931, Karl Jetter, a member of the U. S. Engineer Department staff, initiated attempts to use a small propeller-type current meter. Another member of the staff, Clinton H. Smoke, took up the problem and developed a successful meter in March 1932. Since that time a number of meters of the same type have been built of various materials and with various modifications in the design of blades and pivots. Seven of these are described in Table I and five are pictured in an accompanying illustration.



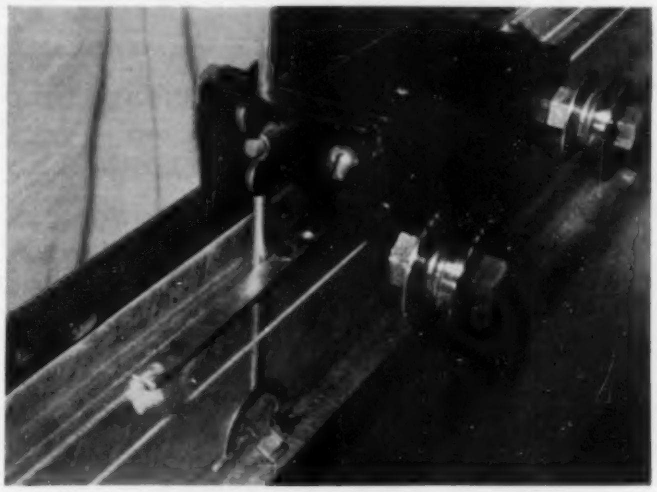
No. 3 No. 4

No. 5 No. 6

No. 7

Aluminum and Vulcanite Propellers for Small Current Meters

Each Propeller Is 1 In. in Diameter Over-All



Rating Equipment with Meter No. 1

Another view shows the rating flume and car, with meter No. 1 in place. In rating, the car is moved at uniform speed by means of a crank and drum at the end of the flume. The time of travel between two fixed points 7 or 8 ft apart is determined by a stop-watch, and the revolutions of the wheel are counted by eye, one vane of each wheel being polished or colored to permit easy observation. Rating curves for the wheels are shown in Fig. 1.

Table I. Description of Small Current Meters Built at Iowa Institute of Hydraulic Research

All Propellers Are 1 In. in Diameter Over-All; All Bearings Are Cup Jewels Taken from Watt-Hour Meters

Meter No.	Propeller	Vanes: Number	Vanes: Angle with Axis	Pivots
1	bakelite, hand-cut	4	30°	phonograph needles; points machined to spherical shape
2	aluminum, formed from flat disk	6	...	phonograph needles; sharp
3	aluminum, cast	4	30°*	nickel silver; spherical
4	aluminum, cast	4	30°*	phonograph needles; sharp
5	aluminum, cast	4	30°*	phosphor bronze; spherical
6	aluminum, cast	4	30°*	tobin bronze; spherical
7	vulcanite, cast	4	60° ±	phonograph needles; sharp

* Curved vane; angle measured at tip of vane.

This method of observation requires some practice, but an experienced operator can obtain remarkably consistent results. Note how little the observed points for meter No. 7 deviate from the mean curve.

These points indicate also the stability of the meter ratings. The circles indicate observations made in November 1932, and the triangles, observations in February 1936. A similar stability was noted with other meters, but the ability of No. 7, the vulcanite wheel, to hold its rating is especially interesting because this was an experimental wheel, not made with particular care and never accurately balanced. It was thought that a

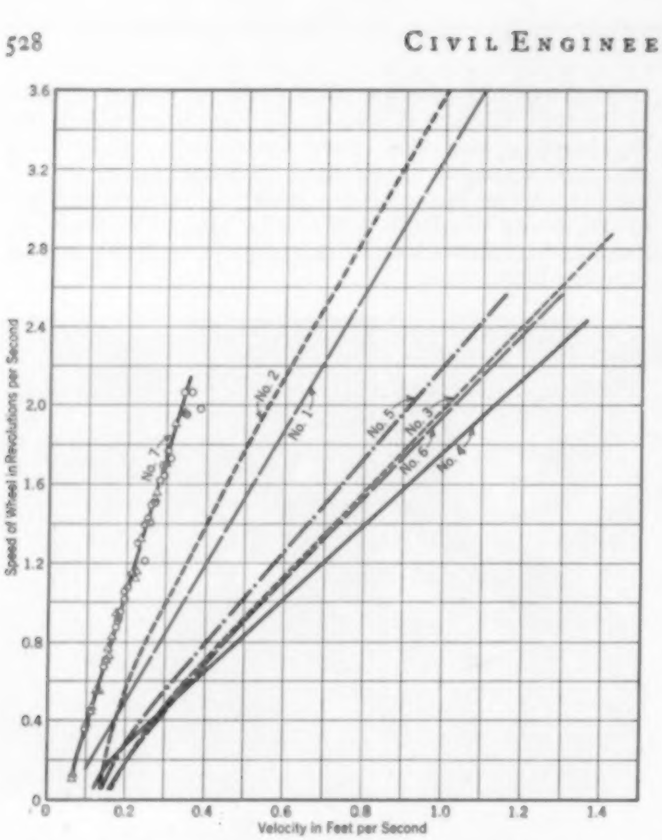


FIG. 1. RATING CURVES FOR SMALL CURRENT METERS

rubber wheel might warp with age, but there is no evidence in the ratings of such distortion.

The effect of holding meter No. 1 at an angle to the current is shown graphically in Fig. 2. The chart indicates, for example, that if the meter is at an angle of 30 deg clockwise with the current, the velocities read from the normal rating curve will be 0.7 of the true velocities past the meter. It will be noted that angularity clockwise with respect to the direction of flow had more effect than a similar angularity in a counterclockwise direction. This was reasonable for a meter rotating clockwise when viewed from upstream.

The ratios in Fig. 2 hold true for the 15-deg angles until the wheel speed reaches 2.0 rps. For the other angles, the plotted ratios are exactly true only at 1.0 rps.

In order to determine the performance of these meters under operating conditions, gagings were made in a river model with meters Nos. 1 and 4. In a stream with a surface width of 2.65 ft, an average depth of 0.12 ft, and a mean velocity of 0.87 ft per sec, meter No. 1 gave a quantity 1 per cent too small—well within the limit of accuracy of the weir used to measure discharge through the model. Meter No. 4 gave discharges averaging 7 per cent too great in two gagings of the same model. In the first gaging, the stream was 2.72 ft wide and 0.14 ft in average depth, and the mean velocity was 0.44 ft per sec; in the second, the width was 3.18 ft, the average depth 0.19 ft, and the mean velocity 0.66 ft per sec.

FIG. 2. EFFECT OF HOLDING METER AT AN ANGLE TO THE CURRENT

The U. S. Geological Survey has recently expressed interest in small meters, and other laboratories are using meters similar to those described here. A general discussion of this type of instrument would be timely and advantageous.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Comments of Members on Manual No. 11

TO THE EDITOR: In looking through the new manual of engineering practice entitled, "Letter Symbols and Glossary for Hydraulics," I noticed what seemed to me to be an error in spelling and two errors in definitions. I believe they are worth calling to the attention of the Special Committee on Irrigation Hydraulics.

On pages 28 and 35, the word "Taintor" appears. The correct spelling, I believe, is "Tainter." I had occasion to look this up for the U. S. Engineer Department and found that United States patents on this type of gate were taken out by Jeremiah Burnham Tainter of Menomonee, Wis., as follows: Patent No. 214,324, April 15, 1879; Patent No. 241,444, May 10, 1881; Patent No. 344,878, July 6, 1886; and Patent No. 344,879, July 6, 1886. Also the *Engineering News-Record*, a few years ago, printed a small notice stating that the correct spelling is "Tainter." In view of these facts, the U. S. Engineer Department adopted this spelling.

On page 21, the definitions of "hydrography" and "hydrology" are given. I believe that, in each case, the secondary definition gives the wrong impression. In the case of hydrography, undue emphasis is laid upon "The science of ... analyzing the flow of water, precipitation, evaporation, and analogous phenomena" when this is the primary function of hydrology. In the case of hydrology, undue emphasis is laid upon "waters of the earth ... often restricted to underground waters in distinction to hydrography as relating to surface water," when hydrology has always been applied to the broad subject of water in all its forms. The fact that one group of persons distorts the meaning of the word to apply it to ground water should in no way influence or detract from the general usage of the word.

Hydrography is the science of determining and recording the disposition, layout, or occurrence of the waters of the earth. It is more in the nature of a survey. Hydrology is the general science treating of the water of the earth in all its forms—precipitation, evaporation, runoff—in which data collected in hydrographic surveys are analyzed and made use of. The root meanings of the

words bear this out, "graphy" meaning "the description of" and "ology" meaning "the science of." The same is true of the similar words, "geography" and "geology." "Geo" means "earth," and geography deals with the description of the earth, while geology is the science of the earth and its various formations.

When I criticize these definitions I am thinking of the wrong usages to which these words may be put because of the over-emphasis of certain minor factors. It is because I feel that the manual is an important contribution to engineering literature that I like to see it as correct as possible. I feel that the committee is to be congratulated on its work.

John C. Harrold, Jun. Am. Soc. C.E.
Engineer, U. S. District Engineer Office

Tucumcari, N.Mex.
January 7, 1936

Dear Sir: One of the items in the Society's Manual No. 11, "Letter Symbols and Glossary for Hydraulics," appeals to me as being in need of clarification. This refers to the definition of "flash-board," appearing on page 17. This device is made synonymous with "stop log" or "stop plank" and described as "held in a slot on the crest of the dam."

Here is a rare opportunity to differentiate between the stop plank or logs that must be removed from the slot by hand or otherwise and the flash-boards that can automatically fall by pushing over their support when the water head reaches a predetermined level. There is such a damaging record of dam failures caused by inability to remove stop logs during floods that flash-boards should not be stigmatized by the similarities. Attention is called to this because of the increasing use of flash-boards and flash-board gates, which have entirely outgrown the stop-log stage and must be differentiated therefrom.

Clifford A. Betts, M. Am. Soc. C.E.
Engineer of Dams, Forest Service
U. S. Department of Agriculture

Washington, D.C.
May 7, 1936

Dear Sir: Since the Society's Manual No. 11 entitled "Letter Symbols and Glossary for Hydraulics" appeared, the foregoing suggestions have been received, which I believe are worthy of being offered for comment. After discussion is closed it may be practicable to have a few revised definitions, which can be cut out and pasted over those in the manual, printed in Civil Engineering.

In addition to the foregoing comments, I should like to point out some corrections. On page 5, the parentheses in p = (2) are a typographical error and should be deleted. Intensity of pressure is of course equal in all directions. The distinction between "total pressure" or force due to a fluid load and "intensity of pressure" or force per unit area is important. In some quarters, particularly among physicists, there is a demand that the word "pressure" alone be taken to mean force per unit area or more briefly "intensity of pressure" or "unit pressure." I do not agree with this demand, and believe "intensity of pressure" is the preferred term. "Unit pressure" has been sanctioned by usage and, if used, must be taken to mean "pressure per unit area."

Mr. Harrold questions the definitions of "hydrography" and "hydrology." and I agree with him. I invite comment on his suggestions.

In connection with the spelling of Tainter gate, it may be noted that, in recent years, the substitute term "radial gate" has come quite generally into use.

On page 30 of the Manual appears a suggestion to substitute the term "sag pipe" for "inverted siphon." Comment is desired on this suggestion as well as on Mr. Betts' suggestion for restricting the definition of "flash-board."

J. C. Stevens, M. Am. Soc. C.E.
Former Secretary, Special Committee on Irrigation Hydraulics

Portland, Ore.
June 15, 1936

The Municipal Bridge at St. Louis Carries Railroad Traffic

To the Editor: Mr. Engel's article, "Some Features of the Mississippi Bridges," in the June issue, states that the Municipal Bridge at St. Louis completed in 1912 is used by highway traffic only. This is incorrect, as the structure has been used for some time by two railroads, and recently an addition to the west approach was built in order to provide for further use by railroad traffic.

The elevation shown in Mr. Engel's Fig. 2 (*d*) seems to be a mutilated drawing of the river spans, as all the subvertical members supporting the top chords are omitted, thus giving a fictitiously light appearance to the trusses as compared with the nine other bridges shown.

At the time these spans were designed, they were longer than any other simple-truss spans in existence and were the first of their kind in which nickel steel was utilized. The bridge structure was amply illustrated in the October 30, 1909, issue of the *Engineering Record.*

The engineers were the late Alfred P. Boller, M. Am. Soc. C.E., and the late Henry W. Hodge, M. Am. Soc. C.E. This information is omitted from the article, although the names of the engineers for the other nine bridges are given.

Howard C. Baird, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.
July 9, 1936

History of Simplified Method of Graphical Analysis

Dear Sir: The graphical method for determining forces in structural engineering presented by Thomas J. Higgins, in the January issue of Civil Engineering, is based upon the long-established theory of parallel coordinates. These coordinates, which are preeminently suited for practical applications, have been introduced in the analysis—first by Chasles (*Correspondence Mathématique de Quételet*, 1829, Vol. VI, page 81) and then independently by W. Unverzagt in 1871, by K. Schwering in 1884, and especially by Maurice d' Ocagne, the founder of the nomography which is widely used by engineers. (See *Nouvelles Annales de Mathématique*, 1884, third series, Vol. III, pages 400, 456, and 516, and *Annales des Ponts et Chausées*, November 1884, page 531. See also his books, *Coordonnées Parallèles et Axiales*, Paris, 1885, and *Traité de Nomographie*, 2d edition, Paris, 1921.) Parallel coordinates for graphical integration of ordinary differential equations have been used by R. Mehmke (*Zeitschrift für angewandte Mathematik und Mechanik*, December 1930, page 602.)

Mr. Higgins is to be commended for bringing to the attention of structural engineers the practical usefulness of these parallel coordinates.

A. Floris

Los Angeles, Calif.
July 3, 1936

Design of Arlington Memorial Bridge Upheld

Dear Sir: The article by J. K. Finch, M. Am. Soc. C.E., on "Engineering and Architecture," in the June issue, is a welcome and significant addition to the perennial subject of the scope of the engineer's and the architect's work. Professor Finch's recognition of their diverse educational backgrounds and his plea for keener engineering sense in the architect and greater esthetic leaning in the engineer should bring about an awakening that will redound to the credit of both professions and the structures they jointly rear. The whole problem is admirably crystallized thus: "The answer to the problem of good design is to be found in cooperation rather

than conflict." To this might be added, "cooperation from the inception of any design." Too much emphasis cannot be placed upon this phase of any work for, as experience in this field will testify, much time, effort, and money have been spent in the injudicious handling of engineering and architectural problems involved in the design of structures.

"Failure on the part of the bridge engineer to give due consideration to the appearance of his bridges reacts as much to his discredit as faulty structural design," says Morris Goodkind in "Architectural Considerations in Bridge Design," in the September 1935 issue of the *American Concrete Institute Journal*. No great architecture has ever been founded on mere usefulness. Enduring designs avoid stark realism, but they do rely upon the correct application of basic principles. Fundamentals are not ephemeral; they are eternal and do not necessarily imply stylistic allegiance. The work of Paul Cret in the facades of the Folger Shakespeare Library in Washington, D.C., is a noteworthy example of the architect's ability to design in the trend known as "modern" without rejecting basic principles of design.

The expressions "honest structure" and "truth-telling structure" have been bandied about so much in the controversy between engineer and architect that it would seem an attempt to discredit the efforts of the architect in assisting the engineer in the control of mass, line, and form.

Reference is made in Professor Finch's article to the use of aluminum spandrel panels in front of the main bascule girders of the Arlington Memorial Bridge, and it is stated that the treatment is "neither structurally nor functionally honest."

Structure is a major element in the composition radiating from and embracing the Lincoln Memorial as a center. Its classical design is in perfect harmony with the memorial, which embodies every known refinement of Greek art. An examination of the drawings reveals a distance of 17 ft 0in. from sidewalk curb to plane of granite facing on approach spans. It appears that a so-called "structurally honest" treatment would have dictated a cantilevered sidewalk, with fascia girders entirely obscured in shadow by the extremely wide overhang. The bascule span would then occupy the dominant position in the facade which would be most undesirable. The aluminum fascia admirably overcomes this objection and also preserves the coplanar fasciae and color similarity through the entire length of the structure. This, we believe, McKim, Mead, and White, the architects, sought rather than a simulation of the stone fascia in the approach spans.

In the March 1932 issue of *Engineering News-Record*, R. S. Foulds stated that, "The design of the Arlington Memorial Bridge was governed largely by architectural considerations. In appearance it is a nine-span arch bridge but it actually consists of eight concrete barrel arches and the bascule in the center which is faced with ornamental metal work to harmonize with the white granite facing of the arches."

The architects for this bridge did not subordinate function to form, as alleged, but rather attained a richness and architectural beauty indicative of the fact that function and form are not incompatible.

The diverse views held by engineers and architects still mitigate against their successful invasion of each other's chosen field. It is therefore earnestly suggested that the best interests of the public would be served through a sensible collaboration of these two professions.

JOHN F. EVANS, JR. *and*
ARTHUR J. LICHTENBERG
Division of Bridges
New Jersey State Highway Department

Trenton, N.J.
June 8, 1936

The Question of Proper Live Load for Designing Stadium Structures

DEAR SIR: I was interested in the article on "The Bessemer High School Stadium" by W. N. Woodbury, in the December issue of CIVIL ENGINEERING. As has been pointed out in subsequent criticism, even a live load, instead of a "total load," of 110 lb per sq ft, described by Mr. Woodbury, is inadequate. A number of building codes specify minimum live loads of 125 lb per sq ft for school and assembly halls (*Carnegie Pocket Companion*, 1934 edition, page 356).

From my own experience, I would say that a live load of 125 lb per sq ft could be attained in any football stadium without the least difficulty. A test was made at Oregon State College to determine possible static balcony loads. After an assembly in the college gymnasium, the college band with their instruments and a few spectators were herded into reasonably close quarters. They were not packed to the extent to be found in some football mass demonstrations. Each individual was weighed after the area was determined. The live load averaged 98.2 lb per sq ft. With possible crowding, and the rhythmic vibrations of college cheering, it would be very easy to exceed 110 lb per sq ft. It is a well-known fact that one kick at a football game will sometimes change a calm orderly crowd into a seething mass of unreasoning humanity.

Mr. Woodbury mentions the fact that spectators tend to form a half moon with the crest at the 50-yd line, when they are permitted to choose their own seats. The accompanying photograph was taken during a minor football game while the Northwestern University stadium was under construction. Seats were not reserved for this game, early arrivals having the first choice. A succession of photographs, taken as the stands filled, would have made an interesting study of the desirability of seats. A photograph of the completed stadium may be found on page 33 of *The Stadium* by M. B. Serby. Gavin Hadden, M. Am. Soc. C.E., was consulting engineer on this stadium, while I was in charge of construction.

JAMES R. GRIFFITH, M. Am. Soc. C.E.
Professor of Structural Engineering
Oregon State College

Corvallis, Ore.
July 7, 1936

DISTRIBUTION OF FOOTBALL SPECTATORS AT NORTHWESTERN UNIVERSITY STADIUM

Deterioration of Structures in Sea Water

DEAR SIR: The splendid article, "Some Data on Beach Protection Works," by M. N. Lipp, Assoc. M. Am. Soc. C.E., in the May issue of CIVIL ENGINEERING, is to be commended, because it brings to the attention of the engineer, who has the responsibility for the design, construction, and maintenance of shore-protection works, information on the various important factors entering into the study of such structures.

In connection with Mr. Lipp's tabulated observations covering 5- and 8-year periods of service life of steel sheet-piling in Florida waters, it may be pertinent to mention the results of the 10-year tests, recently completed by the Committee on Deterioration of Structures in Sea Water (popularly known as the "Sea Action Committee") of the Institution of Civil Engineers of Great Britain. Dr. J. Newton Friend examined the test bars for the committee. Test bars of "Low Moor" wrought-iron were taken as standard. Various steel and steel alloy bars, 60 cm long, 7.5 cm wide, and 1.25 cm thick, were exposed to the air, at half-tide, and submerged, at Plymouth, England; Halifax, Nova Scotia; Auckland, New Zealand; and Colombo, Ceylon.

The appended chart (Fig. 1) and Tables I and II were prepared by the writer as the result of recent studies of various waterfront structural materials, with special regard to the comparative service life rendered by each in the Port of New York and its environs. In studying the steel report of the Sea Action Committee I have for clarity transposed the recorded total losses in grams per 1,000 sq cm of exposed test bar area (with coincidental relative corrosion percentages as compared to the Committee's "Low Moor" wrought-iron standard), to the actual percentages of loss in weight of all bars after 10 years, based upon the computed initial weight of the exposed portions.

TABLE I. OBSERVATIONS ON PITTING OF STEEL AND COPPER-STEEL BARS AFTER 10-YEAR EXPOSURE

LOCATION	STEEL DESIGNATION	REMARKS
Plymouth, England	Steel E	At half-tide, heavily pitted all over
	Steel D	At half-tide, deeply pitted
	Copper Steel G	At half-tide, circular pits, edges severely attacked
	Copper Steel H	Green color, circular pits
Halifax, N.S.	Steels E and D	No comments
	Copper Steel G	At half-tide, uniform attack; submerged, surface rough and pitted
	Copper Steel H	Submerged, steel H was similar to G, but more severely attacked, edges corroded
Auckland, N.Z.	Steel E	Submerged, attacked all over, widespread deep pitting
	Steel D	Submerged, the same as E
	Copper Steel G	Submerged, the same as E; at half-tide, tendency to pit
	Copper Steel H	Submerged, the same as E; at half-tide, a tendency to pit
Colombo, Ceylon	Steel E	At half-tide, honeycomb corrosion, bottom of bar to a knife edge; submerged, heavy pitting
	Steel D	At half-tide, covered with pits, edges corroded away
	Copper Steel G	At half-tide, very deeply pitted; submerged, edges corroded away; covered with pits, some very deep
	Copper Steel H	At half-tide, perforated, very deeply corroded; submerged, edges corroded away, covered with deep pits

TABLE II. OBSERVATIONS ON GENERAL CORROSION OF STEEL AND COPPER-STEEL BARS AFTER 10-YEAR EXPOSURE

STEEL DESIGNATION	EXPOSURE	PER CENT LOSS OF WEIGHT	REFERENCE
Plain steel	In air	3.85 to 54	Fig. 1(a)
Copper steel	In air	2.10 to 53.4	
Plain steel	At half-tide	3.80 to 42.8	Fig. 1(b)
Copper steel	At half-tide	3.20 to 37.2	
Plain steel	Submerged	12.70 to 20.0	Fig. 1(c)
Copper steel	Submerged	12.20 to 21.1	

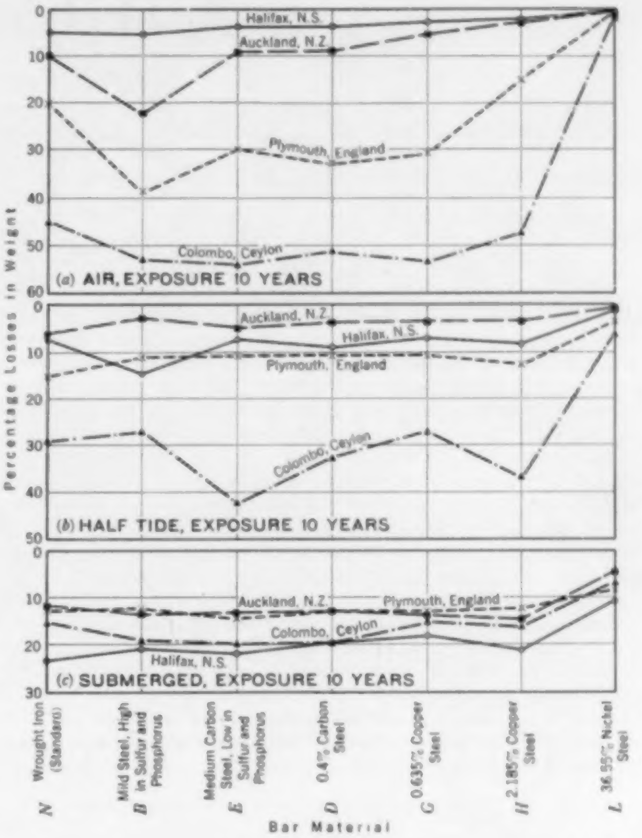


FIG. 1. PERCENTAGE LOSSES IN WEIGHT DUE TO GENERAL CORROSION OF STEEL AND COPPER-STEEL BARS AFTER 10-YEAR EXPOSURE

The entire fifteenth report of the committee, entitled "Deterioration of Structures in Sea Water," by Dr. Friend, dated 1935, will be found of value to those interested in this important subject and will repay study in detail.

RALPH H. MANN, M. Am. Soc. C.E.
Field Engineer, American Wood Preservers Association

New York, N.Y.
July 8, 1936

Important Figure Omitted from Murals

DEAR SIR: The mural paintings on the theme of the Panama Canal in the New York State Roosevelt Memorial Building, reproduced in the February 1936 number, are interesting and beautiful to a high degree. There is, however, one conspicuous omission, the figure of Alfred Noble, President of the Society in 1903—and older engineers who knew him will agree with me in this.

It was Alfred Noble whose conviction and insistence led President Theodore Roosevelt to decide on a lock canal instead of a cut at sea level, as recommended by majority opinion of the international board of engineers—American, English, French, and German, appointed by the President to advise on the question of canal level. It was Alfred Noble who was responsible for route selection and design and who would, as the logical conclusion, have been chief engineer of construction but for his advanced age.

And how well Alfred Noble's judgment was sustained in construction! One has but to think of the Culebra cut.

WILLIAM H. BREITHAUPT, M. Am. Soc. C.E.
Consulting Engineer

Kitchener, Canada
June 10, 1936

SOCIETY AFFAIRS

Official and Semi-Official

Portland Convention—An Outstanding Success

Every Feature Contributes to the Enjoyment of a Splendid Program

WHILE MUCH of the country further east was sweltering under a blistering July hot wave, the Sixty-Sixth Annual Convention of the Society was gathering in Portland, Ore., under bright skies with delightfully cool temperature. Residents refused to claim any special credit for this welcome condition, although the visitors persisted in the belief it was just another example of the careful provisions made for every need and comfort of the large number attending.

Early in the week groups began to gather about the lobby of the Multnomah Hotel. The Conference of Local Sections on Tuesday afternoon, July 14, was the occasion for the first formal meeting. Representatives, singly or in groups of several members, reported for every Section in the Western Meeting Region. In a family atmosphere, local and general Society problems were thrown into the discussion. Society officers and committee members added their quotas to the pool of information. As a result much valuable help was received and contributed by each one in attendance; a feeling of mutuality of interest was established; and a sense of friendly helpfulness and cordial understanding was built up. The success of this early group meeting was typical of what was in store for the other sessions to follow.

URGES STRENGTHENING OF ETHICAL CONSCIOUSNESS

With the Wednesday morning gathering the Convention officially got under way. After genuine greetings of welcome from state and city, Daniel W. Mead, President of the Society, was called upon for the annual presidential address. First, however, he recalled the recent death of former Vice-President David C. Henny, long a resident of Portland, and suggested a standing tribute of silence to the memory of one who had contributed so much to the Society and to his adopted state.

Under the title, "The Engineer and His Code," Dr. Mead in characteristic fashion analyzed some of the shortcomings of the present day, and advocated the extension of the Society's code in scope and use. So deep and general was the acclaim greeting this speech that special arrangements were immediately made to print it complete in the present issue. For record purposes it will also appear in the forthcoming 1936 volume of TRANSACTIONS.

A most enlightening address by Dr. O. O. Winther followed on the subject, "Oregon in a National and World Setting." It gave, especially to visitors, a setting in perspective and in considerable detail, whereby they were better enabled to appreciate local history and geography.

PUBLICIZING SOCIETY PROFESSIONAL WORK

To stress the many efforts in which the Society is engaging to further professional interests, the entire afternoon session was devoted to a symposium in which eight activities were reported. In most cases chairmen or members of committees were present to give the addresses in person. The departments of Society work thus accounted for included the subjects of registration, salary studies, engineering fees, reemployment of engineers, professional development, national relations, education of the public, and Society aims and activities.

In each instance a vivid account of objectives and accomplishments was presented. Necessarily concise to conserve time, the talks were none the less instructive. They pictured an active interest and persistent advance in their varied fields. It is hoped that

PROGRESS IS RAPID ON THE SPILLWAY DAM AT BONNEVILLE
View Taken Looking East

PART OF THE BONNEVILLE PROJECT INSPECTION PARTY, JULY 17, 1936

Daniel W. Mead | Arthur S. Tuttle | Henry E. Riggs | B. A. Etcheverry | Herman Stabler

Ivan C. Crawford | James K. Finch | E. P. Arneson | Raymond A. Hill | C. E. Myers

THE PHOTOGRAPHER SNAPS SOME INFORMAL PORTRAITS OF BOARD MEMBERS AT A TEA AT THE HOME OF MR. and MRS. J. C. STEVENS

the meat of these reports can be printed in a subsequent issue; they will prove instructive and valuable to all Society members.

Technical Papers Cover Wide Interests

Seven of the ten Technical Divisions had arranged individual or joint programs. These occupied the entire day on Thursday, July 16. Particularly notable because of their wide extent and interest were the morning and afternoon sessions sponsored jointly by the Construction, Power, and Waterways Divisions. A large attendance was treated to a series of oral and visual pictures related to the current immense activities of the government on three fronts—at the Fort Peck, Grand Coulee, and Bonneville dams, the latter two within reach of Portland, and the objectives of Society inspection trips in connection with the Convention.

Similarly, the Highway and Structural Divisions combined forces for one morning session. As examples for discussion they took the important problems connected with the work of the Oregon State Highway Department. Of these the design and construction of the monumental new coast highway bridges were of particular moment. Excellent views of these and of other state highway work added to the interest of this meeting.

Both the Irrigation and Sanitary Engineering Divisions held independent afternoon sessions, basing their programs on special features of local or regional interest. Irrigation in the North-Pacific district and near Grand Coulee was amply treated and to a less extent that in other western areas. Problems of Portland's water supply and the pressing needs of stream purification and protection from mosquitoes were also developed. Stream pollution, it was explained, involves a special difficulty through the conflict of obvious manufacturing and civic needs with the preservation of the important fish industry and popular recreational facilities.

These Thursday sessions commanded a wide interest and attendance. Abstracts of all the valuable papers are planned for presentation in the October issue, to enable engineers everywhere to visualize the tremendous problems involved and to evaluate the recent strides made by civil engineering in meeting the technical challenge of the modern age.

Not Forgetting the Social Side

On a par with the Division sessions was the success of the varied social program arranged to the last detail by the local committee. It seemed that the especially large number of ladies in attendance were kept busy continually—morning, afternoon, and evening. Teas, rides, and parties followed one after another, each with its special appeal.

Combined parties were the rule in the evenings. A formal dinner and entertainment was held on Wednesday, featuring an instructive and finely illustrated lecture on "The Lure of the Oregon Country." A well appointed meal contributed to the evening's enjoyment. The following evening, Thursday, was devoted to a dance, enjoyed by older and younger visitors alike.

Some special acknowledgment is due to the crowning social event, an all-day trip to Bonneville Dam enjoyed on Friday. Careful planning resulted in the smoothest possible working of the entire program. Even the weather, in keeping with its past performance, remained perfect. The delightful combination of scenic glories, engineering interest, and local color, gave ample evidence of studied preparation to capture the maximum of total value in a single day.

An Oregon Fish Fry

Although the enthusiastic party embarked by train before breakfast, that necessary meal was not overlooked. To the contrary it was only delayed for an hour, to be enjoyed not only for its own sake but for the unique surroundings that lent zest to it. Thirty miles east of Portland the train stopped at Wahkeena Falls Park, a city-owned recreation center in the famous Columbia River Gorge. The beauties of the river site, of the imposing falls in the side valley, totaling 600 ft or more, and of the nearby Columbia River Highway might in themselves entrance a visitor.

But the members of the party had only incidental interest for the moment in such matters; their attention was drawn to an appetizing aroma, due to nothing less than a fish fry. Awaiting them on tables set in the open were delicious cut-throat trout cooked to a turn, together with innumerable "fixings." Thus the local members treated their guests to a famous Oregon meal, one that will long be remembered.

Bonneville and Return

Another train ride brought the party to Booneville Dam, and a full four hours was available to inspect it. In the auditorium, engineers explained the project and demonstrated by models its function and working. Then the inspection began, including the numerous fishways in the various structures, the housing of the power plant and its two 300-ton cranes, the largely completed lock structures giving a single lift of 66 ft, and the main fishways on Bradford Island. The main dam on the north branch also proved

of interest. Over 200,000 cu ft per sec was passing through the south part already largely completed, and through part of the power house. The completion of the upstream leg of the north cofferdam, washed out by the 1936 flood, also proved exceedingly interesting.

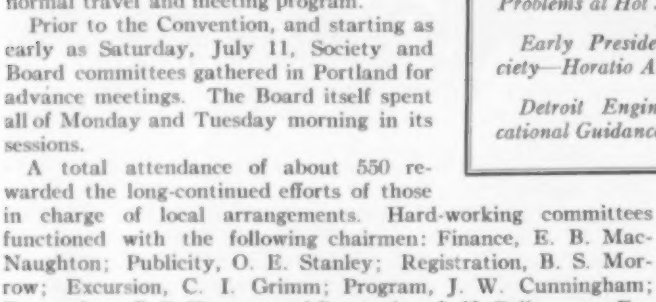
A hearty dinner was served at the mess hall of the Columbia Construction Company, and all too soon it was time to begin the return trip. This part of the journey was by auto stage along the renowned Columbia River Highway. Stops enroute permitted views of Horsetail Falls, Multnomah Falls, and Crown Point Vista House. By the scenic Sandy River Gorge the cars returned to Portland in the late afternoon.

OTHER TRIPS ENJOYED

Inspections of local water works and power projects were provided for Saturday; also a longer trip to leave for Spokane on Friday evening and to Grand Coulee Dam on Saturday. A quite extensive trip on the way to the Portland Convention also deserves mention. About twenty members with their families left Chicago on July 5, stopping en route for one day each at Fort Peck and Grand Coulee dams and for two days in Glacier National Park. All these trips provided delightful interludes in the normal travel and meeting program.

Prior to the Convention, and starting as early as Saturday, July 11, Society and Board committees gathered in Portland for advance meetings. The Board itself spent all of Monday and Tuesday morning in its sessions.

A total attendance of about 550 rewarded the long-continued efforts of those in charge of local arrangements. Hard-working committees functioned with the following chairmen: Finance, E. B. MacNaughton; Publicity, O. E. Stanley; Registration, B. S. Morrow; Excursion, C. I. Grimm; Program, J. W. Cunningham; Decorations, C. P. Keyser; and Recreation, J. H. Polhemus. For the Ladies Entertainment, Mrs. Lyman Griswold was chairman. J. C. Stevens served as general chairman of the entire group.



EDITORIAL STAFF WHOSE ILLUSTRATED DAILY BULLETINS OF THE CONVENTION WERE A GREAT SUCCESS

From Left to Right: Orrin E. Stanley, Kenneth L. Coltrin, and Percy H. Bliss

CONVENTION OUTSTANDING IN EVERY WAY

Under present plans it will be two years before another Annual Convention is held in the West. Thus the Portland Convention closes a notable cycle of many delightful events in this area. It will be long remembered as outstanding in every feature. The natural glories of the western country, the warm hospitality of the local engineers, and the splendid technical program all contributed to the success of the meeting. The combination proved irresistible. All who were able to be in Portland at this time are eagerly awaiting the opportunity to return.

Meeting of Board of Direction, July 13 and 14, 1936—Secretary's Abstract

ON JULY 13 and 14, 1936, the Board of Direction met at the Multnomah Hotel in Portland, Ore., with President Daniel W. Mead in the chair. In addition, Secretary Seabury and the following members of the Board were present: Messrs. Arneson, Barbour, Crawford, Eddy, Etcheverry, Ferebee, Finch, Hidinger, Hill, Leisen, McDonald, Myers, Proctor, Riggs, Stabler, Trout, Tuttle, and Wilkerson.

In This Issue . . .

Approval of Minutes

The Board approved the minutes of its meeting on April 20 and 21, 1936, and those of the Executive Committee meeting on July 12, 1936.

Economic Studies

The Board authorized a small committee to survey the practicability of undertaking studies of the importance of heavy engineering works in comparison with light structures or other contributory and alleviating measures to determine their relative effects upon floods.

To Fill Vacancies

The Board authorized the appointment of representatives to fill vacancies on the Library Board of the Engineering Societies Library; on the Research Procedure Committee of the Engineering Foundation; on the Washington Award Commission; on the Board of Trustees of United Engineering Trustees, Inc.; and on the Engineers' Council for Professional Development.

History of Engineering

In the spring of 1935 the Board appointed J. K. Finch and R. S. Kirby, Members Am. Soc. C.E., to act with similar representatives of other bodies to consider the organization of a Joint Committee on the History of Engineering. As suggested by Director Finch, approval was given to the proposed committee.

Professional Conduct

After full consideration by the Society's Committee on Professional Conduct of a case of alleged unethical conduct, due notice of the charges and opportunity for hearing having been given, the Board continued its regular procedure, the ballot resulting in the expulsion of one member of the Society.

Future Society Meetings

Slightly modifying its recent practice, the Board decided to hold its Annual Convention in 1937 at the city of Detroit. It was further decided that the 1937 Spring Meeting would be held in San Antonio, Tex., and the meeting in the fall of 1937 at Boston.

Grade of Student Member

A recommendation was presented from the Student Chapter Committee and from a conference of representatives of the Buffalo, Lehigh Valley, Syracuse, Rochester, and Ithaca Sections, requesting that the grade of Student Member be established. This proposal was referred to the Committee on Student Chapters with instructions to submit a draft of a suitable constitutional amendment for detailed study by the Board at its October meeting.

Defense of Members

In line with the procedure adopted by the Board in April of 1935, for the defense of members against unjust accusation or dismissal, the Board gave careful consideration to the circumstances surrounding the dismissal and resignation of two former federal employees and took action looking towards their defense.

"Life Members"

Preliminary notice, as required by the By-laws, was given as to a proposed amendment to the By-laws to make provision for the use of the term "Life Member" for those members exempted by the

Constitution from the payment of dues. The proposed amendment specifies that the use of the "term 'Life Member' shall not be construed to establish a separate grade of membership."

Committees

Reports were received from the following committees: Executive, Publications, Professional Conduct, Honorary Membership, Districts and Zones, Accredited Schools, Local Sections, Student Chapters, Fees, and Salaries.

Mississippi State College Student Chapter

Supporting the recommendation of the Committee on Student Chapters, approval was given to the reinstatement of the Student Chapter at Mississippi State College.

Aims and Activities

A report from the Committee on Aims and Activities advised that after a careful consideration of the possibilities of group insurance as applicable to the members of the Society, the committee had determined this to be inadvisable as inequitable in its cost. The committee recommended the establishment of the grade of Student Member; also the undertaking of certain proposed activities and the intensifying of certain present activities, this portion of the report being referred to the Executive Committee for special consideration.

Freeman Scholarship

Upon the recommendation of the Committee on the Freeman Traveling Scholarship, the Board awarded the 1936–1937 scholarship to John Hedberg, Jun. Am. Soc. C.E., Assistant Professor at Stanford University.

U. S. Civil Service Classification to Be Basis for Studies of Positions and Compensation

The Board adopted the following resolution:

"*Resolved* that the system of classification of positions promulgated by the United States in the Classification Act of 1923 and amendments thereto, as expanded and applied by the U. S. Civil Service Commission, with such modification in detail as may be necessary, be adopted for use in studies of civil engineering positions and compensation therefor undertaken on behalf of the American Society of Civil Engineers."

Merit System

Upon recommendation of a special committee the Board gave renewed endorsement of the merit system.

New Soils Mechanics and Foundations Division

Petition being received from 20 corporate members, the Board approved the formation of a new Technical Division to be known as the Soils Mechanics and Foundations Division, upon presentation and acceptance of the proper constitution, by-laws, and nominations of executive committee members.

Expansion of Local Sections

The conference of Local Sections at Hot Springs, Ark., requested the drafting of a practicable plan for allocating each member of the Society to existing or new Local Sections. A plan deemed suitable, based on certain premises which may or may not be found acceptable, received detailed study. This plan is to be taken up with the officers of the Local Sections, and their recommendations and comments are to be considered by the Board at its October meeting.

Miscellaneous Matters

Other administrative matters were discussed and acted upon.

Adjournment

The Board adjourned to meet at Pittsburgh, Pa., on October 11, 1936, in connection with the Fall Meeting of the Society.

Secretary's Abstract of Executive Committee Meeting

On July 12, 1936, the Executive Committee of the Society met at Portland, Ore., with President Daniel W. Mead in the chair. Present were Secretary Seabury and Messrs. Eddy, Riggs, and Tuttle.

Approval of Minutes

The minutes of the meeting of the Executive Committee held on April 20, 1936, were approved.

Society Investments

The Committee gave consideration to the transfer of certain of the Society's securities which had matured, been called, or which it seemed advisable to sell; and to the reinvestment of the funds thus acquired.

Administrative Matters

Several items of administrative detail relating to committees or to those groups or joint agencies with which the Society is affiliated were determined.

Fall Meeting to Be at Pittsburgh, October 13–17, 1936

Three Local Sections are cooperating actively with the local committee and the Technical Divisions in arranging the program for the Fall Meeting of the Society, to be held at Pittsburgh, Pa., October 13–17, 1936. The Pittsburgh Section, in addition to acting as host to the visiting members, has arranged a lively discussion of flood control problems and is cooperating with the Structural Division in the presentation of a symposium on the structural applications of steel and light-weight alloys; also with the City Planning and Surveying and Mapping Divisions in preparing their programs.

The Cleveland Section, in conjunction with the Sanitary Engineering Division, is sponsoring a symposium on stream pollution, and the Central Ohio Section has joined with the Highway Division in preparing a technical session on modern highway design and construction.

In all, eight Technical Divisions are to be represented on the program. In addition to those already mentioned, the Waterways Division has scheduled two sessions, and the Power and the Engineering-Economics and Finance Divisions will hold two combined sessions. As a result, the Fall Meeting will depart from the customary four-day schedule and begin on Tuesday, reserving the morning and afternoon of the opening day for two general sessions.

Flood control has been selected as the subject of these general sessions. The floods recently experienced by Pittsburgh and many other cities of the eastern states, and the impetus given to flood control by congressional action a short time later, provide the background for a timely discussion that should attract the attention of the general public as well as of engineers. Wednesday and Thursday will provide two full days for the technical sessions.

Plans for a large part of the program are already complete. Most of the papers have been prepared for some time, and each author has had an opportunity to correlate his work with that of the others. Thus, "isolated" papers and duplications will be avoided, and each session will be given over to the consideration of one definite topic.

Friday will be reserved for excursions to some of the Pittsburgh laboratories and industries. These excursions, as far as possible, will be correlated with the papers presented at the technical sessions. The program so far prepared is of unusual general and technical interest in keeping with the engineering importance of the Pittsburgh, Cleveland, and Central Ohio regions.

During the Meeting, representatives of 28 Local Sections will attend a regional conference to discuss problems that have already been given attention at Hot Springs and Portland. A detailed abstract of the Hot Springs conference has been mailed to all Local Sections, and a similar review of the Portland proceedings will be made available some time in August, so that while the agenda remain the same, the full conference will be able to take up the discussion where it was left off at the other meetings. A regional conference of Student Chapters is also scheduled.

The committee of the Pittsburgh Section in charge of arrangements for the Fall Meeting consists of A. V. Karpov, chairman, and the following: U. N. Arthur, W. H. Buente, John N. Chester, Robert A. Cummings, Allen S. Davison, R. P. Forsberg, E. N. Hunting, H. D. Johnson, Jr., Richard Khuen, Jr., J. F. Laboon, M. G. Mansfield, L. C. McCandliss, L. W. McIntyre, E. K. Morse, John M. Rice, L. J. Riegler, and C. B. Stanton. George E. Barnes and George B. Gascoigne represent the Cleveland Section, and R. R. Litehiser and William E. Burroughs the Central Ohio Section.

Early Presidents of the Society

This is the fifth of a series of biographies of outstanding American engineers of the nineteenth century. In the remaining months of 1936 the stories of Julius Walker Adams, George Sears Greene, Ellis Sylvester Chesbrough, and William Milnor Roberts will be told. Readers are invited to help in preparing these articles by contributing pertinent photographs, facts, and anecdotes.

V. HORATIO ALLEN, 1802–1889
President of the Society, 1871–1873

ON THE NINTH of August 1829, the town of Honesdale, Pa., turned out for a show. Down by the canal bank men were hoisting a strange iron contraption from a boat and easing it into place on a wooden track. The crowd was excited, skeptical. The blacksmith shook his head emphatically.

"She'll smash them rails," he said. "Or if she don't, she'll pitch off that trestle into the creek."

A young man, busy directing the process, smiled quietly and went on about his work. The engine settled into place; the wooden beams creaked—but held. Fuel was brought, and as the engine got up steam the crowd milled about, examining it carefully, admiring the lion proudly emblazoned on its boiler front, and squinting critically down the track.


HORATIO ALLEN
FIFTH PRESIDENT OF THE SOCIETY

At length the young man climbed aboard; the crowd dropped back. His hand went to the throttle-valve; there was a hiss of steam, and amid the cheers of the onlookers the locomotive slowly moved forward. A minute later it had successfully negotiated the curved trestle and was lost to view in the forest beyond.

Such was the birth of steam railroading in the United States. The engine was the "Stourbridge Lion"; the young man at the throttle was Horatio Allen.

Four years before, locomotives had first gone into permanent and successful use on the Stockton and Darlington Railroad, in England. Allen, a resident engineer for the Delaware and Hudson Canal Company, foresaw their possibilities and decided to go to England to study their working. Before he left, his company entrusted him with the purchase of several, which they planned to use in transporting coal from their mines in the Susquehanna Valley to the head of the canal system leading to New York. At this time Allen was but 25 years of age.

In Liverpool he made the acquaintance of George Stephenson, from whom he received "every kindness, and all the aid that was at his command." After considerable study, he placed an order for one locomotive with the Stephensons, and another, for three of a somewhat different design, with Rastrick and Company. The "Stourbridge Lion" was one of the latter.

Allen left the Canal Company immediately after the test of the Lion, and became chief engineer of the South Carolina Railroad. This line was to extend from Charleston, on the ocean, to a point opposite Augusta, Ga., a distance of about 150 miles. Let us follow his own story of some of its early problems:

"The first question to be decided was that of the motive power to be used. On the other side of the Atlantic, two eminent civil engineers" had recommended to the Liverpool and Manchester Company "a succession of stationary engines transmitting a tractive force by use of long ropes." An English publication had currently asserted that nothing could do more harm to the adoption of railroads "than the promulgation of such nonsense as that we shall see locomotives traveling at the rate of 12 miles per hour." On this side of the water some 16 miles of the Baltimore and Ohio road had been constructed, and was worked by horsepower.

Allen reported, however, in favor of locomotives. He showed them to be more economical than horsepower, and added that "in the future there is no reason to expect any material improvement in the breed of horses, while in my judgment the man is not living who knows what the breed of locomotives is to place at command."

This report was submitted at a full meeting of the board, and was adopted unanimously—"the first act by a corporate body in the world to adopt the locomotive as the tractive power on a railroad for general passenger and freight transportation."

Rails for the South Carolina road were 6 by 12-in. timbers to which iron bars $2\frac{1}{2}$ by $\frac{1}{2}$ in. in section were spiked. "Confidence and capital had not yet reached the growth to make an iron track of the most modest weight a possibility." The permissible limit of wheel load on such tracks soon led to the development of six- and eight-wheeled locomotives. Allen proposed the scheme and superintended the design, and an eight-wheeled engine was put in operation on the road in February 1832.

This fact and date were later important. In 1834 a patent was granted to Ross Winans, of Baltimore, for eight-wheeled cars with two trucks. Another company later began their manufacture, denying the validity of his patent. After 20 years of litigation the case reached the Supreme Court, and was decided against Mr. Winans largely on the evidence produced by Allen of his prior use of the same principle.

But to go back to the South Carolina days: "That the locomotive was to be used in the night was plainly to be anticipated," continues Allen in his brochure, *The Railroad Era*. To provide illumination, "two platform cars were placed in front of the locomotive. On the forward platform was placed an inclosure of sand, and on the sand a structure of iron rods somewhat of urn shape. In this structure was to be kept up a fire of pinewood knots." At the operating speed then possible, the scheme was apparently satisfactory.

After completing the South Carolina Railroad, Allen married, toured Europe for almost three years, and returned to New York to find John B. Jervis, his former chief of Delaware and Hudson Canal days, busy on plans for the Croton Aqueduct. Allen became his principal assistant, stayed with the job until its completion, and later became a member of the Croton Aqueduct Commission. It is interesting to note that Allen recommended crossing the Harlem River by tunnel instead of by bridge. Despite the fact that his proposal was easily the cheaper of the two he was overruled—apparently because of the hazards involved in tunnel construction. Something like a half-century later, the new Croton aqueduct was put across in tunnel.

About 1842 Allen became one of the proprietors of the celebrated Novelty Works in New York. The "novelties" his company produced were substantial gadgets indeed—hydraulic presses, sugar mill machinery, and marine engines—and as a matter of fact the rather incongruous name was inherited rather than adopted. Some years before, Dr. Nott, president of Union College, had invented a stove and a steam boiler for burning anthracite coal. To show the practicability of his invention he had a small steamboat built called the *Novelty*, which ran from New York to Harlem. At night this boat was laid up at a landing at the foot of 12th Street. A small shed was erected there, with a few tools for doing repairs on the boat. This shop was extended, and came to be known as the "Novelty's works," and afterwards passed into the hands of a Mr. Stillman, who did various kinds of machine work there.

After Allen entered the firm the business grew rapidly in various directions, finally becoming the largest establishment in the country for building marine engines. The machinery for many of the steamers of the old Collins Line and of the Pacific Mail Steamship Company was built there, as well as that for two Italian warships and for a number of vessels and monitors for the United States during the Civil War. Among the latter might be mentioned the sloops *Adirondack* and *Wampanoag*, and the double-turreted monitor *Miantonomah*.

At one time there were more than 1,500 men employed in the Novelty Works, and so great was the difficulty of getting men at

ALLEN AS A YOUNG MAN

that time, owing to the demands of the Army and Navy, that Allen went to Europe and employed a large number there who were brought over.

In 1863 Allen was appointed by the Secretary of the Navy to work with Mr. Isherwood, the chief of the Bureau of Steam Engineering of the Navy, "to devise and conduct a set of experiments to ascertain the relative economy of using steam with different measures of expansion." This work was commenced on a large scale. Engines with various-sized cylinders were constructed, and connected with a large fan, the revolutions of which represented the work done. While the tests were insufficient to settle all the points at issue, they did demonstrate that the economical point of cut-off becomes shorter as the pressure is increased, but that with any pressure the most economical degree of expansion is soon reached and the cost rises rapidly after this point is passed.

During all of Allen's career he was a prolific inventor; between 1841 and 1879 he was a regular customer of the patent office. Most of his patents were in connection with steam engines and their appurtenances. His method of connecting condenser tubes to their heads, with compressed wooden ferules, was extensively adopted.

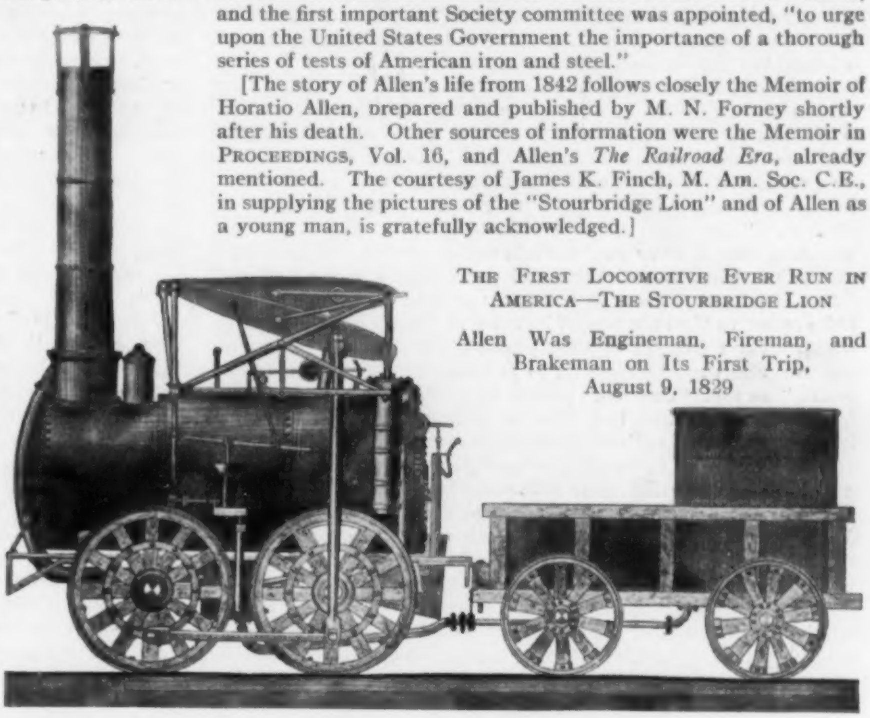
When the Civil War ended there was, of course, a cessation of government work. Business at the Novelty Works had been conducted on a large scale, and the establishment soon found itself operating at a loss. As the real estate had by that time become very valuable, the business was dissolved in 1870 and the Novelty Works ceased to exist.

During Allen's connection with that firm, he also acted in the capacity of consulting engineer for the Erie Railroad, and for a year as its president and chief engineer. He was also consulting engineer to the Panama Railroad Company for a short time. His active professional career may be said to have ended as consulting engineer of the Brooklyn Bridge.

In 1870 he retired and built a house at Montrose, N.J., where he resided until his death in 1889. He always seemed to derive his chief enjoyment in life from his delightful home, and especially so during the latter years of his life—though he took a lively interest in engineering, scientific, and especially educational matters, up to the last. His love for children led him to sympathize with them in their struggles for early knowledge, and to aid them he published simple books on arithmetic and algebra. After the love for his profession, the study of astronomy came nearest to him, and he published a work on that subject and invented a device for demonstrating the motions of the planets, and other astronomical instruments for school use.

In the first two years of his retirement, Mr. Allen served as President of the Society. During his term of office, several important events occurred. In 1873 the Annual Convention was held outside of New York for the first time. The place selected was Louisville, and the Convention "was attended by the largest number of civil engineers (79) ever assembled on this continent." The Society had by that time become definitely national in its scope; 70 per cent of its total membership was non-resident. Also during Allen's incumbency the first volume of TRANSACTIONS was issued; the Secretary of the Society was made a salaried officer; George H. Norman established the fund for the medal that bears his name; and the first important Society committee was appointed, "to urge upon the United States Government the importance of a thorough series of tests of American iron and steel."

[The story of Allen's life from 1842 follows closely the Memoir of Horatio Allen, prepared and published by M. N. Forney shortly after his death. Other sources of information were the Memoir in PROCEEDINGS, Vol. 16, and Allen's *The Railroad Era*, already mentioned. The courtesy of James K. Finch, M. Am. Soc. C.E., in supplying the pictures of the "Stourbridge Lion" and of Allen as a young man, is gratefully acknowledged.]



THE FIRST LOCOMOTIVE EVER RUN IN AMERICA—THE STOURBRIDGE LION

Allen Was Engineman, Fireman, and Brakeman on Its First Trip, August 9, 1829

Students Discuss Chapter Problems at Hot Springs Conference

FIFTY MEMBERS of Student Chapters and 26 members of the Society attended the conference of Student Chapter representatives at Hot Springs, Ark., on April 23, 1936. Important items on the agenda included the following three questions: (1) How would you organize and conduct a regional conference of Student Chapters? (2) How would you organize and conduct a Chapter's part in an engineer's day or open house? (3) How can the contact member be of most service to the Chapter?

Regional conferences, it was pointed out, are distinct from the conferences held in connection with Society meetings. They are organized by the students themselves, and are sponsored by a group of Chapters in a definite neighborhood that get together annually for such joint activities as suit their particular needs. They are not "shows put on by the host Chapter," but rather "the product of the work of all the Chapters attending."

"Each conference should have a definite aim—a special problem to discuss," said one representative. "Registration laws, professional ethics, and problems that the young engineer will face soon after he graduates, are fine topics for such meetings."

Another representative warned against including too many speeches on the program. "Remember that these boys are lectured and talked at every day," he said, "I suggest that these conferences be real student meetings. Limit the outside speakers to one representative of the national Society and one of the neighboring Local Sections. If possible, schedule an inspection trip to points of historical interest, engineering projects, or manufacturing plants. Wind up with a dinner or dinner dance; an amateur floor show can be put on at little expense."

Some Chapters reported that student paper competitions had aroused high interest at regional conferences. Various schemes for conducting them were described in the June 1936 issue of CIVIL ENGINEERING.

Engineering open houses are held at many schools. It was suggested that some of them appeared to be "just frolics that do not represent anything of consequence such as might be expected from students preparing themselves for a professional career." On the other hand, several representatives described exhibits of a serious nature that had made such events interesting and instructive. Some programs had been planned to attract the attention of high school students to the work of the civil engineering curriculum; others were arranged for the benefit of parents; still others catered

asserted that nothing could do more harm to the adoption of rail- Novelty Works, and so great was the difficulty of getting men at

to the liberal arts students, or to the residents of the surrounding community. One professor stated that he believes the construction of certain types of exhibits is as valuable as the regularly prescribed laboratory work, and that he gives his students academic credit for such activities.

"Some of the other departments," said one representative, "have more opportunity to 'put on stunts' than do the civil engineers. Civils can have a live program, however, featuring models of bridges, buildings, and other structures. Someone should be on hand to explain them." One school reported a highway exhibit that contained models of roads from the time of the Romans to the modern clover-leaf intersections.

Contact members were described as the link between the Student Chapters and the practicing profession. "Our daily classes train us in technique, but there are many important subjects that can't be found in the curriculum. If these men could open the students' eyes to problems that are not in the textbooks, it would not only be stimulating to the Chapter meetings, but a great future help to the students as well." It was suggested that in many cases the contact member might fail to assist simply because of modesty. Chapter officers were advised to invite them to each individual meeting, and to ask for their suggestions in preparing programs and special activities.

Engineering aptitude tests for college freshmen were discussed by C. V. Mann, M. Am. Soc. C.E. His address will appear as an article in the September issue of CIVIL ENGINEERING.

Past-President Tuttle addressed the group on the topic, "How can the Local Sections be of most service to the Chapters?" His speech will be abstracted in a later issue. He was followed by President Mead and Past-President Talbot, both of whom stressed the broadening effect of engineering organizations, especially as they foster acquaintanceship among active engineering practitioners. "The most valuable organizations," said Dr. Talbot, "are those that do not always stick to technical work, but give their members a chance to get thoroughly acquainted with each other."

Dr. Mead stated that he believed the function of the Society with respect to the members of its Student Chapters is to bring to them a clearer concept of what practice will mean to the young engineer, and what he must do to fit himself for it. "It is unfortunate," he said, "that some young men go into practice without ever having been told how they should conduct themselves. I believe it is almost entirely through ignorance that they get into trouble. I am glad to see that some of the universities and colleges are beginning to realize their obligation in this line; courses are beginning to appear that are devoted to studying the relations of the engineer to his client, to his associates, to the public—in other words, his duties as a citizen. I sincerely hope that the activities of the Student Chapters may also help along that line. Student Chapters might take up the question of ethics—it does not matter whether much comes of the discussion provided the students begin to think a little about these matters that are so essential to them as citizens."

A detailed abstract of the conference proceedings has been prepared and approximately 700 copies of it, together with an equal number of reprints of Professor Mann's article, will be distributed in September to Student Chapter presidents and secretaries, faculty advisers, contact members, secretaries of Local Sections, and other persons officially connected with Student Chapter activities.

Juniors in Colorado Section Affairs

LETTERHEADS of the Colorado Section of the American Society of Civil Engineers for 1935–1936 list two unusual semi-official positions. Below the names of the regular officers are found the titles of two Juniors of the Society—the "junior representative to the president" and the "junior assistant to the secretary." These appointments have resulted from the willing assistance often lent the president and secretary by the younger men of the Section, and from the recommendations of the Society's Committee on Juniors that the younger men should be drawn into a more active relationship by placing them on committees.

The junior representative to the president is an important liaison officer between the president and members of all grades. He is selected by the president of the Section from a list of three candidates nominated by the directing committee of the Junior Association from former members of that committee.

A variety of tasks are assigned to this representative. Among them might be mentioned in particular the preparation of a "nameplate board." The idea, suggested by a former California Junior, has stimulated friendliness at meetings and may be useful in other Local Sections. The nameplates are mounted on a plain canvas board, and each member secures his as he enters the room. At the close of the meeting the plates are deposited in a box, and are later replaced on the board by the junior representative.

"LET ME THINK—IS HIS NAME SMITH, OR JONES?"

The Colorado Section's Use of Nameplates Has Eliminated Those Embarrassing Lapses of Memory and Stimulated a Feeling of Friendship. H. J. Tebow, Junior Representative to the Section President, Is Standing Beside the Board

It is probable that few Local Section secretaries need any explanation of the uses of a junior assistant. He may be called upon, for example, to help prepare and mail announcements, to act as secretary pro tem, assist in keeping a cash book, canvass for dues, and keep tab on dinner reservation calls and of attendance at meetings. The practice in Denver is for the secretary to choose a Junior for his assistant from among his acquaintances, one requirement being proximity to the secretary's office.

At present H. J. Tebow is the junior representative to the president, and M. F. Maloney is the junior assistant to the secretary. Mr. Tebow, who supplied the foregoing information, goes on to tell of some of the work of the Junior Association of the Colorado Section.

Although holding its separate meetings and attempting to give the Juniors more opportunity for active participation than they can expect in the Local Section itself, the Junior Association works hand in hand with the Section and is constantly encouraging its own members to take an active interest in the Local Section.

Believing that the Local Section programs should emphasize discussion and social "mixing," the Juniors last year sponsored a recommendation that scheduled technical talks should occupy only one hour of the meeting, leaving the second hour open and informal. The recommendation was adopted and has worked out successfully.

"I am confident," writes Mr. Tebow, "that if officers of the several Local Sections having a large number of Juniors respond in the same spirit of cooperation and good fellowship displayed by the officers of the Colorado Section, the interest and cooperation of the Juniors will be sustained throughout the Society.

"Colleges and universities turn out great numbers of young engineers each year. Many of them, though connected with Student Chapters, do not take advantage of their eligibility for Junior membership in the Society upon graduation. A similar period of indecision sometimes attacks the Junior when he becomes eligible for corporate membership in the Society. There is little reason to doubt that he will apply for the change in grade if as a Junior he has been made a part of the Local Section and has been active therein. Activity in the Junior organizations within the Local Sections, if supplemented by participation in the Local Section program, will be no bar to the Junior's continued interest in the Society. The Juniors are entirely capable of advancing along the lines of the ideals of the Society. Their relations with the Local Sections must, however, be left to the officers themselves, the most sincere cooperation being necessary.

"There appears to be no reason why groups of Juniors, too small to support a Junior organization, should not be recognized by appointment to semi-official positions as in the Colorado Section. It is a gesture that any Local Section president may do well to follow. It offers to the young engineer a most potent invitation to Local Section activity."

The Education of the Engineer

First Release of Data from Survey of the Engineering Profession Conducted by the U. S. Bureau of Labor Statistics

In the spring and early summer of 1935, the Bureau of Labor Statistics of the Federal Government, with the assistance of the American Engineering Council and many engineering societies, conducted a survey of the engineering profession in the United States. Readers of "Civil Engineering" will recall several articles during 1935 recording the progress of that survey and the considerable part played by the American Society of Civil Engineers. Every member of the Society was sent a copy of the questionnaire direct from the Bureau and had the opportunity to record significant data from his own professional career. In order to bring these results directly to the attention of engineers as quickly as possible, Dr. Isador Lubin, Commissioner of the Bureau of Labor Statistics, furnished copies of the first release to the Founder Societies simultaneously with its appearance in the June "Monthly Labor Review." A résumé of that article, and excerpts from it, including five tables, are here presented.

THE U. S. Bureau of Labor Statistics has just released the first section of its report on the findings of the Survey of the Engineering Profession. It was prepared by Andrew Fraser, Jr., of the Bureau's Division of Wages, Hours, and Working Conditions.

Table I. Distribution of Professional Engineers Reporting, by Geographical Division and State

Geographical Division and State	No. Reporting	Geographical Division and State	No. Reporting
United States	52,589	New England	4,674
		Connecticut	934
District of Columbia	948	Maine	322
East South Central	1,544	Massachusetts	2,717
Alabama	343	New Hampshire	227
Kentucky	402	Rhode Island	313
Mississippi	268	Vermont	161
Tennessee	531	West North Central	4,978
Mountain	2,434	Iowa	902
Arizona	369	Kansas	740
Colorado	908	Minnesota	1,265
Idaho	197	Missouri	1,224
Montana	291	Nebraska	398
Nevada	101	North Dakota	172
New Mexico	156	South Dakota	277
Utah	254	Pacific	5,651
Wyoming	158	California	4,389
West South Central	2,486	Oregon	427
Arkansas	171	Washington	835
Louisiana	481	East North Central	10,977
Oklahoma	509	Illinois	3,689
Texas	1,325	Indiana	1,316
South Atlantic	3,920	Michigan	1,951
Delaware	195	Ohio	2,999
Florida	626	Wisconsin	1,022
Georgia	592	Middle Atlantic	14,977
Maryland	628	New Jersey	3,323
North Carolina	421	New York	7,659
South Carolina	295	Pennsylvania	3,995
Virginia	678		
West Virginia	485		

This release deals with the educational background of the 52,589 engineers who replied to the questionnaire sent out in May 1935. Subsequent releases will deal with conditions of employment, salaries, and other valuable statistics secured in this study. The educational data were the first completed and appeared in the June 1936 issue of the *Monthly Labor Review.*

General Conclusions

A number of significant facts stand out from these first-hand data on the education of engineers. A first degree in engineering is now nearly a prerequisite for obtaining professional status and a position. Postgraduate work is important only in a few of the professional classes. The tendency of engineers to transfer from the course of college specialization to other classes of work is negligible. A study of the tables included in this article will reveal other conclusions and comparisons now established on an adequate statistical foundation.

Scope and Method

The principal purpose of this survey was to determine how the engineers fared during the depression period. More specifically, the objectives were to determine the extent of unemployment, what kind of professional employment gave engineers the greatest protection against unemployment, where they found substitute employment, and their compensation between December 31, 1929, and December 31, 1934. However, to provide a comprehensive background for these data, the survey was extended to include the salient features of education and subsequent experience, so that the nature of the general trends affecting the profession could more readily be determined. Unquestionably, a knowledge of trends is of inestimable value to administrators of professional engineering education and to the practicing and prospective engineer.

The data were obtained through the medium of a mail questionnaire, requesting information, for the three periods ending December 31, 1929, 1932, and 1934, on: present city and state residence; marital status and number of dependents; type of education; employment; unemployment; earnings; membership in engineering societies; method of obtaining employment, together with information on contract, patent, pension, and civil-service privileges; field of activity; functional classification; and professional class. A copy of this questionnaire was sent to each of 173,151 engineers.

The mailing list for the questionnaire was compiled for the Bureau through the cooperation of national, state, and local engineering societies, and additional names were obtained from 32 state boards of engineer examiners and the deans of 156 engineering schools. At the time the requests for names were issued, there were known to be in existence 80 national, 42 state, and 197 local societies, and of these 73, 39, and 121 respectively submitted names from their past and present membership rosters. Obviously, since the cooperating bodies embraced every phase of professional activity, the original mailing list, from which duplications were eliminated, can be accepted with little question as being adequate.

Of the 173,151 questionnaires sent out, 58,388, or 33.7 per cent, were returned with information; 5,883, or 3.4 per cent, were returned as "not found"; and no replies were received for 108,880,

Table II. Geographical Distribution of the Nine Major Professional Classes of Engineers

Professional Class	Total	Geographical Division: District of Columbia	East South Central	Mountain	West South Central	South Atlantic	New England	West North Central	Pacific	East North Central	Middle Atlantic
United States	52,589	948	1,544	2,434	2,486	3,920	4,674	4,978	5,651	10,977	14,977
Agricultural	397	9	21	20	36	38	10	123	38	71	31
Architectural	538	10	8	20	22	29	44	107	30	139	129
Ceramic	388	3	11	2	5	22	10	38	26	169	102
Chemical	3,512	37	107	108	213	291	360	296	179	878	1,034
Civil	19,891	450	707	1,191	1,082	1,619	1,631	2,295	3,099	3,244	4,523
Electrical	11,443	195	286	385	480	856	1,080	991	920	2,412	3,829
Industrial	1,007	6	19	14	18	76	129	56	44	270	375
Mechanical	13,226	197	320	285	548	898	1,313	884	986	3,343	4,452
Mining and metallurgical	2,187	41	65	409	73	91	88	188	320	401	502

The junior representative to the president is an important liaison officer between the president and members of all grades. He is selected by the president of the Section from a list of three candi-

It is a gesture that any Local Section president may do well to follow. It offers to the young engineer a most potent invitation to Local Section activity."

or 62.9 per cent. The net number of usable returns was 52,589, or 30.4 per cent of the number of persons on the original mailing list, a most gratifying response, especially in view of the fact that no follow-up method was used.

The returns covered every state in the Union and the District of Columbia, ranging in number from 101 in Nevada to 7,659 in New York. In view of the small number of returns from individual states—in only 13 cases were more than 1,000 reports received from a single state, while in 24 states less than 500 were received—the states were grouped according to the census geographical divisions with the single exception of the District of Columbia, which was segregated from the South Atlantic region and presented separately. This segregation was deemed advisable owing to the fact that the majority of engineers reporting from the District of Columbia were in the employ of the federal government.

The number of professional engineers reporting from each region and state appears in Table I. In this table the geographic divisions are arranged in ascending order, according to the number of reports received.

The engineers reporting were grouped into nine major professional classes, as are shown in Table II. Each of the minor professional classes, too small to justify separate analysis, was combined with the major professional class to which it is most closely allied. The returns by major classes varied from 388 for ceramic engineers to 19,891 for civil engineers. Each of these groups was analyzed on a national basis, thus permitting comparisons between groups.

Nature of Educational Data

It should be noted that no specific information as to curricula was requested in the educational section of the survey. The only questions asked were with respect to the particular type of education received. These types embraced secondary school, noncollegiate technical school, university, or college, including nongraduate, graduate, and postgraduate work. In each case the questionnaire called for the number of years of attendance, the name of the institution, the course taken (whether liberal arts, civil engineering, or other course), and the date of graduation.

One of the basic objectives of the survey was to show trends. This article will show (1) the prevalence of first degrees in engineering, (2) the extent of postgraduate work, (3) the tendency of engineers to transfer from the course of specialization to other professional fields, (4) the nature of the distribution as between all graduates and non-graduates of "other engineers," and (5) the general relation of education to fields of activity and functional classifications. Engineering graduates are those who reported having obtained an engineering degree from a college or university, while "other engineers" include all those who received a secondary school, non-collegiate, non-graduate, or non-engineering education.

The distribution of the nine professional classes by type of education in the country as a whole, as of 1934, is shown in Table III. The reader will be well repaid for a few minutes of thoughtful study of this table. To facilitate the analysis, the engineers reporting were divided into three groups as follows:

All Engineers Reporting		
Engineering Graduates in		All Other Engineers
Same Class as College Course (Group 1)	Different Class from College Course (Group 2)	(Group 3)

Attention is called particularly to the prevalence of first degrees and of postgraduate degrees in the various professional classes, which by this arrangement can be readily noted with respect to

D. L. S. 960 STRICTLY CONFIDENTIAL

U. S. DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS
WASHINGTON

SURVEY OF THE ENGINEERING PROFESSION
Undertaken at the Request of the American Engineering Council

1. STATE .... NAME .... (Optional. Requested only to aid editing in case of error)
2. CITY .... BUSINESS ADDRESS, IF ANY .... (Otherwise home address)
3. YEAR OF BIRTH ....
4. ARE YOU MARRIED? YES ...... NO ...... NUMBER OF DEPENDENTS .... (Including wife, if married)

5. Education:	Number of years attended	Name of institution	Course taken (e. g. civil engineering, liberal arts, etc.)	Date of graduation
a. Secondary schools (High or preparatory) ....(1)				
b. Noncollegiate technical schools (Day or evening, beyond secondary schools) ....(2)				
c. University or college ....(3)				
d. Graduate work ....(4)				

(Detach Here and Return Questionnaire Only)

6. Employment: The Bureau is tracing the change in engineering opportunities since 1929. Please indicate your major occupation by using a check in the appropriate space to indicate an affirmative answer to describe your status at the END of each of the THREE years.	End of year— 1934	1932	1929
a. Were you engaged in engineering in a private firm or organization? (Excluding private consulting work and teaching) ....(1)			
b. Were you engaged in engineering on private consulting work?			
(1) As independent consultant ....(2)			
(2) As employee of private consulting firm ....(3)			
c. Were you engaged in engineering as an employee of a public authority (excluding work relief)?			
(1) Federal Government ....(4)			
(2) State Government ....(5)			
(3) County Government ....(6)			
(4) Municipal Government ....(7)			
(5) Other public authority (please specify) ....(8)			
d. Were you teaching engineering subjects as a member of an engineering faculty? ....(9)			
e. Were you employed on nonengineering work? (Including teaching other than that indicated under (d), but excluding direct relief or work relief) ....(10)			
Specify nature of work			
f. Were you on work relief? (Specify relief agency and nature of work) ....(11)			
g. Any other employment (please specify) ....(12)			
h. Were you wholly unemployed? ....(13)			
i. Were you on direct relief (excluding work relief)? ....(14)			

7. UNEMPLOYMENT AND RELIEF (during 60 months from Jan. 1, 1930, to Dec. 31, 1934):
a. Number of months totally unemployed (Excluding months on work relief or C. W. A.) ....(1).. .... If none please check here ......
b. Number of months on work relief or C. W. A. ....(2).. .... If none please check here ......
c. Number of months on direct relief (Excluding months on work relief or C. W. A.) ....(3).. .... If none please check here ......

(1)

FIRST TWO PAGES OF QUESTIONNAIRE SENT OUT BY THE U. S. BUR

Industrial	1,007	6	19	14	18	76	129	56	44	270	375
Mechanical	13,226	197	320	285	548	898	1,313	884	986	3,343	4,452
Mining and metallurgical	2,187	41	65	409	73	91	88	188	329	401	502

(a) the class, indicating the field of practice, and (b) the group, indicating the origin of their professional training.

For example, among 19,891 civil engineers, 13,004, or 65.4 per cent, are practicing in the same class in which their first degree was taken, and of these, 12,302, or 61.9 per cent, had only the one degree. A much smaller group, only 1,657, or 8.3 per cent, received their first degree in some other class, such as mechanical or electrical engineering. The remainder, 5,191 civil engineers, or 26.1 per cent, reported that they did not possess an engineering degree, or possessing one, were not practicing in an engineering field. This last group included 2,950, or 14.8 per cent, who started a college engineering course but did not finish it; 1,124, or 5.7 per cent, who got their training in non-collegiate technical schools; 511, or 2.6 per cent, whose formal education was confined to secondary schools only (high school, etc.); and 457, or 2.3 per cent, who had a degree but not in an engineering course (as an A.B. or B.S. degree). Besides these, there were 149 men, or 0.7 per cent, who were engineering graduates and had taken other degrees besides, but who reported that they are working in non-engineering fields. In fact, among all engineers reporting (52,590) only 498, or 0.9 per cent, said they were out of engineering.

Graduate study in engineering does not appear to be of any considerable importance as a prerequisite to practice in the engineering field. In certain classes, as in agricultural and chemical engineering, graduate degrees appear to be of some importance, but among civil engineers trained as such, only 680, or 3.4 per cent, have masters' degrees, and 22, or 0.1 per cent, have doctorates in engineering, while among those trained in other branches but now practicing as civil engineers, 75, or 0.4 per cent have masters' degrees, and 10, or 0.05 per cent, have doctorates in engineering.

Of the 52,589 engineers reporting, only 4,413, or 8.4 per cent, were graduates in engineering who were practicing in another branch of the profession than the one for which they had qualified in college. As noted above, this is almost the exact proportion of civil engineers in the same situation. If this tendency had been very marked, it would undoubtedly have had reactions on curricula. A certain number of transfers are to be expected anyhow, so it may be safely concluded that, by and large, the respective curricula meet the needs of the engineering profession.

Other Engineers

Considering the group of "other engineers" as a whole, 1,304, or 3.5 per cent, are found to have had degrees in the liberal arts but are now, without further formal engineering training, doing engineering work. It is not a very large proportion but it is interesting to note that this group has remained fairly constant since as far back as 1889. It is difficult to explain how such a group is able to attain professional status without formal education in the engineering field, although this is more readily seen in certain fields, such as chemical, ceramic, mining and metallurgical, and architectural engineering. Nevertheless, it can be safely concluded that since graduates of academic courses have been in engineering fields over a long period, the probability is that they will continue to remain a factor in the profession.

Engineering educators have for many years been aware that the "mortality" (that is, the proportion dropping out before completion of the course) among engineering students is very high, this having been disclosed by many previous studies. The number covered by the present survey who reported that they did not finish the engineering course in college was 5,651, or 10.8 per cent of the total. Taking the individual professional classes, the largest percentage was found among civil engineers, 14.8, ranging from that point downward to 4.1 per cent among the ceramic engineers.

Again examining the entire group of reporting engineers, we find that 967, or 1.8 per cent, had only a secondary school education. The largest numbers were civil and mechanical engineers, the total of these being 756, or 78.2 per cent, of the 967 reporting.

Breaking down the total number of engineers into (a) recent accessions to the profession, and (b) the older men, let us look first at the "recent" graduates, or those who entered the profession since the 1930 census. We find that 18,451, or 98.48 per cent, reported that they received a degree between 1930 and 1934. Only 286, or 1.52 per cent, were not gradu-

8. Earned income (please give data for each year):

	From salaries or personal services in both engineering and nonengineering work	*Average monthly rate from engineering work for time actually employed*
a. For year ending December 31, 1934 ....(1)..		
b. For year ending December 31, 1932 ....(2)..		
c. For year ending December 31, 1929 ....(3)..		

9. Have you ever been a member of an engineering or allied technical society?

	Name of society	*Now a member*	*Formerly a member*
National societies........			
State societies........			
Local societies........			

Answer questions 10, 11, 12, 13, and 14 only if you had an engineering job at the end of 1934

10. Employment contract:

a. Are you under contract for your position? (1) Yes ...... No ...... For what period? ....

b. In the event of separation does your contract require a waiting period before taking similar work? (2) Yes .... No .... How many months? ....

c. Have you the right to patent or to receive special compensation for inventions and improvements?

(1) Made in the course of your work (3)..............

(2) Not directly related to your work (4)..............

d. Have you pension privileges? (5)........... Contributory .... Noncontributory ....

e. Are you under civil service? (6)...........

11. Source of information used to locate present position (please check media used):

a. ...... (1) Engineering society.
b. ...... (2) Private employment agency.
c. ...... (3) United States Employment or Reemployment Service.
d. ...... (4) Other public employment service (specify) ....
e. ...... (5) Personal contacts and recommendations.
f. ...... (6) Newspapers.
g. ...... (7) Technical journals.
h. ...... (8) Any other medium,

12. At the end of 1934, in what industry, service, or zone of interest were you employed? (See "Industry, Service, or Zone of Interest" on opposite page—Classification I.)

....
(Answer here, as "Public Utilities—Gas")

13. What principal function did you perform in that work? (See "Functional Classification" on opposite page—Classification II.)

....
(Answer here, as "Operation—Testing")

14. What was your professional classification as an engineer? (Mechanical, civil, electrical, mining, metallurgical, chemical, marine, industrial (not otherwise classified), agricultural, military, naval architect, etc.)

....
(Answer here, as "Chemical")

(2) 14—2667

Of Labor Statistics for Its Survey of the Engineering Profession

professional classes by type of education in the country as a whole,

First Two Pages of Questionnaire Sent Out by the U. S. Bureau of La

Table III. Distribution of the Professional Classes of Engineers in the United States, 1934, by Type of Education

Type of Education	Agricultural No.	Agricultural % of total	Agricultural % of professional class	Architectural No.	Architectural % of total	Architectural % of professional class	Ceramic No.	Ceramic % of total	Ceramic % of professional class	Chemical No.	Chemical % of total	Chemical % of professional class	Civil No.	Civil % of total	Civil % of professional class
Engineering Graduates															
Group I															
Course same as professional class:															
First degree in engineering	201	82.4	50.6	338	94.2	62.8	294	90.2	75.8	2,486	84.3	70.9	12,302	94.6	61.9
Engineering only	200	82.0	50.3	329	91.7	61.2	289	88.7	74.5	2,386	80.8	68.0	11,884	91.3	59.8
Engineering, plus B.A. in liberal arts	1	0.4	0.3	9	2.5	1.6	4	1.2	1.0	89	3.0	2.5	376	2.9	1.9
Engineering, plus M.A. in liberal arts	...	...	...	...	...	...	1	0.3	0.3	6	0.2	0.2	33	0.3	0.2
Engineering, plus Ph.D. in liberal arts	...	...	...	...	...	...	...	...	...	8	0.3	0.2	9	0.1	...
Master's degree in engineering	42	17.2	10.5	21	5.8	3.9	30	9.2	7.7	363	12.3	10.4	680	5.2	3.4
Engineering only	42	17.2	10.5	21	5.8	3.9	30	9.2	7.7	360	12.2	10.3	673	5.1	3.4
Engineering, plus B.A. in liberal arts	...	...	...	...	...	...	...	...	...	3	0.1	0.1	8	0.1	..
Doctor's degree in engineering	1	0.4	0.3	...	...	...	2	0.6	0.5	100	3.4	2.8	27	0.2	0.1
Total	244	100.0	61.4	359	100.0	66.7	326	100.0	84.0	2,951	100.0	84.1	13,004	100.0	65.4
Group II															
Course different from professional class:															
First degree in engineering	97	87.4	24.5	38	97.5	7.1	15	75.0	3.9	121	84.0	3.5	1,572	94.9	7.8
Engineering only	92	82.9	23.2	38	97.5	7.1	14	70.0	3.6	117	81.2	3.4	1,521	91.7	7.6
Engineering, plus B.A. in liberal arts	4	3.6	1.0	...	...	...	1	5.0	0.3	4	2.8	0.1	49	3.0	0.3
Engineering, plus M.A. in liberal arts	1	0.9	0.3	...	...	...	...	...	...	...	...	...	1	0.1	...
Engineering, plus Ph.D. in liberal arts	...	...	...	...	...	...	...	...	...	...	...	...	1	0.1	...
Master's degree in engineering	14	12.6	3.5	1	2.5	0.2	5	25.0	1.3	19	13.2	0.5	75	4.5	0.4
Engineering only	14	12.6	3.5	1	2.5	0.2	5	25.0	1.3	18	12.5	0.5	73	4.4	0.4
Engineering, plus B.A. in liberal arts	...	...	...	...	...	...	...	...	...	1	0.7	...	2	0.1	...
Doctor's degree in engineering	...	...	...	...	...	...	...	...	...	4	2.8	0.1	10	0.6	0.1
Total	111	100.0	28.0	39	100.0	7.3	20	100.0	5.2	144	100.0	4.1	1,657	100.0	8.3
Other Engineers															
Group III															
Non-engineering graduates	13	...	3.3	36	...	6.7	16	...	4.1	212	...	6.0	457	...	2.3
Engineering graduates (with other degrees) in non-engineering fields	1	...	0.3	...	...	...	...	...	...	23	...	0.7	149	...	0.7
College engineering course, unfinished	17	...	4.3	67	...	12.5	16	...	4.1	154	...	4.3	2,950	...	14.8
Non-collegiate technical-school engineers	5	...	1.3	26	...	4.8	5	...	1.3	20	...	0.6	1,124	...	5.7
Secondary-school engineers	6	...	1.5	6	...	1.1	5	...	1.3	3	...	0.1	511	...	2.6
Total	42	...	10.6	135	...	25.1	42	...	10.8	412	...	11.7	5,191	...	26.1
Total, not reporting	...	...	...	5	...	0.9	...	...	...	5	...	0.1	39	...	0.2
Grand total	397	...	100.0	538	...	100.0	388	...	100.0	3,512	...	100.0	19,891	...	100.0

Type of Education	Electrical No.	Electrical % of total	Electrical % of professional class	Industrial No.	Industrial % of total	Industrial % of professional class	Mechanical No.	Mechanical % of total	Mechanical % of professional class	Mining and Metallurgical No.	Mining and Metallurgical % of total	Mining and Metallurgical % of professional class	Total No.	Total % of total	Total % of professional class
Engineering Graduates															
Group I															
Course same as professional class:															
First degree in engineering	8,460	91.7	73.9	403	95.9	40.0	8,390	94.1	63.4	1,306	89.4	62.5	34,242	92.6	65.1
Engineering only	8,165	88.4	71.4	389	92.6	38.6	8,174	91.7	61.9	1,280	84.0	58.8	33,056	89.5	62.9
Engineering, plus B.A. in liberal arts	248	2.7	2.1	13	3.1	1.3	197	2.2	1.4	66	4.3	3.0	1,000	2.7	1.9
Engineering, plus M.A. in liberal arts	26	0.3	0.2	1	0.2	0.1	14	0.1	0.1	5	0.3	0.2	86	0.2	0.2
Engineering, plus Ph.D. in liberal arts	24	0.3	0.2	...	...	...	5	...	..	12	0.8	0.5	58	0.2	0.1
Master's degree in engineering	699	7.6	6.1	15	3.7	1.5	483	5.4	3.7	144	9.4	6.5	2,477	6.7	4.7
Engineering only	689	7.5	6.0	13	3.1	1.3	479	5.4	3.7	141	9.2	6.4	2,448	6.6	4.6
Engineering, plus B.A. in liberal arts	9	0.1	0.1	2	0.5	0.2	4	..	..	3	0.2	0.1	29	0.1	0.1
Doctor's degree in engineering	65	0.7	0.6	2	0.5	0.2	42	0.5	0.3	18	1.2	0.8	257	0.7	0.5
Total	9,222	100.0	80.6	420	100.0	41.7	8,915	100.0	67.4	1,336	100.0	60.8	36,989	100.0	70.3
Group II															
Course different from professional class:															
First degree in engineering	333	92.0	3.0	343	95.0	34.0	1,356	94.1	10.3	234	84.1	10.7	4,109	93.1	7.8
Engineering only	322	89.0	2.9	332	91.9	32.9	1,309	90.9	10.0	218	78.4	10.0	3,963	89.8	7.6
Engineering, plus B.A. in liberal arts	10	2.8	0.1	10	2.8	1.0	38	2.6	0.3	12	4.3	0.5	130	2.9	0.2
Engineering, plus M.A. in liberal arts	...	...	...	...	1.3	0.1	6	0.4	...	2	0.7	0.1	11	0.2	...
Engineering, plus Ph.D. in liberal arts	1	0.3	...	...	...	...	3	0.2	...	2	0.7	0.1	7	0.2	...
Master's degree in engineering	25	6.9	0.2	15	4.2	1.5	79	5.5	0.6	31	11.2	1.4	264	6.0	0.5
Engineering only	24	6.6	0.2	15	4.2	1.5	75	5.2	0.6	31	11.2	1.4	256	5.8	0.5
Engineering, plus B.A. in liberal arts	1	0.3	...	...	...	...	4	0.3	...	...	...	...	8	0.2	...
Doctor's degree in engineering	4	1.1	...	3	0.8	0.3	6	0.4	...	13	4.7	0.6	40	0.9	0.1
Total	362	100.0	3.2	361	100.0	35.8	1,441	100.0	10.9	278	100.0	12.7	4,413	100.0	8.4
Other Engineers															
Group III															
Non-engineering graduates	206	...	1.8	33	...	3.3	240	...	1.8	91	..	4.2	1,304	...	2.5
Engineering graduates (with other degrees) in non-engineering fields	110	...	1.0	23	...	2.3	174	...	1.3	9	...	0.4	488	...	0.9
College engineering course, unfinished	862	...	7.5	97	...	9.6	1,299	...	9.9	180	...	8.7	5,651	...	10.8
Non-collegiate technical-school engineers	517	...	4.5	52	...	5.2	879	...	6.7	55	...	2.5	2,683	...	5.1
Secondary-school engineers	140	...	1.2	18	...	1.8	245	...	1.8	33	...	1.5	967	...	1.8
Total	1,844	...	16.1	223	...	22.2	2,837	...	21.5	377	...	17.3	11,103	...	21.1
Total, not reporting	15	...	0.1	3	...	0.3	33	...	0.2	4	...	0.2	104	...	0.2
Grand total	11,443	...	100.0	1,007	...	100.0	13,226	...	100.0	2,187	.	100.0	52,580	...	100.0

Table IV. Distribution of Non-Graduates Among "Other Engineers," by Year of Birth in the United States, 1934

Education	Born in Period	Total: Number	Total: Per Cent	Agricultural	Architectural	Ceramic	Chemical	Civil	Electrical	Industrial	Mechanical	Mining and Metallurgical
Non-graduate engineers:												
College engineering course unfinished	1910–14	218	3.9	...	2	1	15	94	49	5	39	13
	1905–09	738	13.1	...	12	4	32	352	153	16	150	19
	1900–04	914	16.2	3	9	3	21	443	198	13	211	13
	1895–99	899	15.9	3	6	3	22	435	157	29	215	29
	1890–94	790	14.0	7	13	2	17	412	101	13	202	23
	1885–89	790	14.0	1	13	3	16	450	88	11	176	32
	1880–84	596	10.5	3	5	...	14	341	57	6	144	26
	1875–79	348	6.1	...	2	...	7	212	34	2	76	15
	1874*	358	6.3	...	5	...	10	211	25	2	86	19
Total		5,651	100.0	17	67	16	154	2,950	862	97	1,299	189
Non-collegiate technical school	1910–14	52	1.9	...	...	...	1	14	22	...	13	2
	1905–09	224	8.3	...	2	2	2	88	84	3	43	...
	1900–04	360	13.4	...	3	...	3	144	99	8	100	3
	1895–99	375	14.0	1	3	1	2	156	84	7	113	8
	1890–94	476	17.8	1	4	...	6	201	68	14	175	7
	1885–89	452	16.8	1	6	...	3	186	70	6	169	11
	1880–84	358	13.4	...	4	...	1	169	49	8	119	8
	1875–79	199	7.4	1	1	2	2	84	28	6	72	3
	1874*	187	7.0	1	3	...	...	82	13	...	75	13
Total		2,683	100.0	5	26	5	20	1,124	517	52	879	55
Secondary school	1910–14	16	1.7	...	...	1	...	5	7	...	2	1
	1905–09	88	9.1	...	...	...	2	49	25	...	12	...
	1900–04	110	11.4	1	...	...	1	57	24	...	25	2
	1895–99	128	13.2	...	...	4	...	58	21	3	36	6
	1890–94	152	15.7	2	1	...	...	78	17	4	45	5
	1885–89	165	17.1	3	2	...	...	86	19	7	43	5
	1880–84	108	11.1	...	...	...	...	56	13	1	35	2
	1875–79	83	8.6	...	...	...	...	50	8	1	20	3
	1874*	117	12.1	...	3	...	...	72	6	2	27	4
Total		967	100.0	6	6	5	3	511	140	18	245	33
Total non-graduate engineers		9,301	17.7	28	99	26	177	4,585	1,519	167	2,423	277
Graduate engineers		43,288	82.3	369	439	362	3,335	15,306	9,924	840	10,803	1,910
Grand total		52,580	100.0	397	538	388	3,512	19,891	11,443	1,007	13,226	2,187

* Or earlier.

ates but nevertheless had begun to practice since 1930. On the other hand, there are 33,852 older engineers, of whom 24,837, or 73.4 per cent, reported graduation up to and including 1929. The remainder of the older men totals 9,015, or 26.57 per cent, who did not graduate in engineering. This enormous decrease in "other engineers," or non-graduates (from 26.57 to 1.52), is the best evidence that graduation in engineering is almost a necessity today for entry into the profession.

The demand for graduation as a qualification for professional status in engineering is not a recent development; it is a growing trend that may be traced back for more than 50 years. This is clearly brought out by Table IV, which presents data for the three classes of non-graduates of the "other engineers," showing in each case their distribution by year of birth as of 1934. In the case of engineers who did not complete their college course the percentage in each age classification rises gradually to 16.2 for those born in 1900–1904, after which it declines to 3.9 for the persons born during 1910–1914. The decline in the percentage is even more marked in the case of engineers from non-collegiate technical and secondary schools. Among engineers in the first of these two groups the peak was reached with a percentage of 17.8 for those born in 1890–1894, dropping to only 1.9 per cent for the period 1910–1914. Likewise, for engineers in the latter schools, the highest point, namely, 17.1 per cent, was attained for 1885–1889, following which it fell to only 1.7 per cent in 1910–1914. The small percentage of recent engineers, compared to the large percentage of older engineers, in each of these three groups of non-graduates again emphasizes the fact that the chances of attaining professional status without a college degree have markedly decreased.

Fields and Functions

Data were requested as to the field of activity and the functional classification of the engineer. Only those engineers who had an engineering job as of December 31, 1934, were interrogated on these points; this explains the two totals in Table V, given as "reporting" and "not reporting" the field of activity and functional classification in the nine professional classes.

Strictly speaking, the fields of activity and functional classifications may be more simply described as the branches of engineering engaged in and the functions performed in those branches. With respect to the field of activity, this is quite obvious in some instances, such as mining and metallurgical engineering.

Of the agricultural engineers reporting as employed on December 31, 1934, no less than 51.5 per cent were in government work, probably due to the great demand for engineers in such work as soil erosion, irrigation, etc. Personal service absorbed 27.7 per cent of

Table V. Distribution of Engineers by Zones of Interest and Functional Classifications in the United States, 1934

Classification	Agricultural Number	Agricultural Per Cent	Architectural Number	Architectural Per Cent	Ceramic Number	Ceramic Per Cent	Chemical Number	Chemical Per Cent	Civil Number	Civil Per Cent
Field of Activity										
Construction	29	9.4	91	39.4	5	1.9	32	1.4	2,148	15.4
Extractive industries	...	...	2	0.9	8	3.0	147	6.7	447	3.2
Public utilities	13	4.3	11	4.7	1	0.4	104	4.7	484	3.5
Transportation	...	...	...	...	...	...	18	0.8	517	3.7
Manufacturing	21	6.8	23	10.0	231	86.8	1,592	72.0	705	5.1
Personal service	85	27.7	11	4.7	14	5.3	171	7.7	808	5.8
Agriculture and forestry	1	0.3	...	...	...	...	...	...	...	...
Government work*	158	51.5	93	40.3	7	2.6	148	6.7	8,812	63.3
Total	307	100.0	231	100.0	266	100.0	2,212	100.0	13,921	100.0
Total not reporting	90	...	307	...	122	...	1,300	...	5,970	...
Functional Classification										
Design and research	60	22.5	72	31.2	77	28.9	727	32.9	3,030	21.8
Construction	85	27.7	102	44.1	9	3.4	48	2.1	6,368	45.7
Operation	22	7.1	13	5.7	138	51.9	1,051	47.5	1,741	12.5
Consulting†	34	11.1	17	7.3	8	3.0	95	4.3	874	6.3
Teaching	62	20.2	9	3.9	11	4.2	128	5.8	553	4.0
Sales	12	3.9	7	3.0	8	3.0	67	3.1	175	1.2
General administration and management	23	7.5	11	4.8	15	5.6	96	4.3	1,180	8.5
Total	307	100.0	231	100.0	266	100.0	2,212	100.0	13,921	100.0
Total not reporting	90	...	307	...	122	...	1,300	...	5,970	...

Classification	Electrical Number	Electrical Per Cent	Industrial Number	Industrial Per Cent	Mechanical Number	Mechanical Per Cent	Mining and Metal Number	Mining and Metal Per Cent	Total Number	Total Per Cent
Field of Activity										
Construction	184	2.8	35	5.1	762	8.7	22	1.5	3,308	9.6
Extractive industries	126	1.9	25	3.7	328	3.7	684	47.3	1,767	5.1
Public utilities	2,634	39.7	60	8.8	734	8.4	19	1.3	4,060	11.8
Transportation	199	3.0	19	2.8	429	4.9	4	0.2	1,186	3.5
Manufacturing	2,231	33.7	456	66.8	4,841	55.2	399	27.7	10,499	30.4
Personal service	602	9.1	55	8.1	866	9.9	160	11.0	2,772	8.1
Agriculture and forestry	...	...	...	...	1	‡	...	...	2	‡
Government work*	650	9.8	32	4.7	803	9.2	160	11.0	10,863	31.5
Total	6,626	100.0	682	100.0	8,764	100.0	1,448	100.0	34,457	100.
Total not reporting	4,817	...	325	...	4,462	...	739	...	18,132	...
Functional Classification										
Design and research	1,846	27.9	92	13.5	2,960	33.8	281	19.4	9,154	26.6
Construction	717	10.8	42	6.1	841	9.6	97	6.7	8,309	24.1
Operation	2,261	34.1	229	33.6	2,271	25.9	629	43.4	8,355	24.2
Consulting†	423	6.4	67	9.8	507	5.8	161	11.2	2,186	6.4
Teaching	487	7.3	24	3.6	635	7.2	127	8.7	2,036	5.9
Sales	434	6.6	41	6.0	777	8.9	28	2.0	1,549	4.5
General administration and management	458	6.9	187	27.4	773	8.8	125	8.6	2,868	8.3
Total	6,626	100.0	682	100.0	8,764	100.0	1,448	100.0	34,457	100.0
Total not reporting	4,817	...	325	...	4,462	...	739	...	18,132	...

* Includes federal, state, county, and municipal.
† Includes independent consultants and employees of consulting firms.
‡ Less than one-tenth of 1 per cent.

the total, the remaining agricultural engineers being distributed in construction, manufacturing, public utilities, and private agriculture and forestry. Referring to the distribution by functional classification, 27.7 per cent of the agricultural engineers were in construction, 22.5 per cent in design and research, and 20.2 per cent in teaching.

The architectural engineers also found government work the best recent possibility for employment, with 40.3 per cent so employed; 39.4 per cent were in private construction, and only 10 per cent in manufacturing, the remainder being in public utilities, personal service, and extractive industries. As regards the functional classifications, 44.1 per cent were in construction and 31.2 per cent in design and research.

Ceramic and chemical engineers are very similar with regard to their distributions in both the fields of activity and functional classifications. In each case, the largest percentage is to be noted in manufacturing, the figures being 86.8 for ceramic and 72 for chemical engineering. The number engaged in government work formed only 6.7 per cent of the chemical, and 2.6 per cent of the ceramic engineers. For the functional classifications, each of these two professional classes had the largest percentages in design and research and in operation.

Referring to civil engineers, the percentage of those employed by governmental agencies is no less than 63.3, the next highest being those in private organizations rendering engineering service, with only 15.4 per cent. This unusually large relative number in government work is explained primarily by the almost complete cessation, during the period immediately preceding the survey, of civil engineering opportunities in the normal fields of activity other than government. In the distribution of the civil engineers with regard to functional classifications, construction leads with 45.7 per cent, followed by design and research with 21.8 per cent, and operation with 12.5 per cent—a total of 90 per cent in these three classifications.

As anticipated, the percentage of electrical engineers in public utilities is high, being 39.7, but it is also interesting to note that as many as 33.7 per cent reported manufacturing as their field of activity. No less than 9.8 per cent were in government work, and 9.1 per cent were in personal service. Again (as for civil engineers) the first three functional classifications cover 72 per cent of all reporting, although the order is operation with 34.1 per cent, design and research with 27.9 per cent, and construction with 10.8 per cent.

Industrial and mechanical engineers are largely in manufacturing, the former having 66.8 per cent and the latter 52.2 per cent of the total. In the case of industrial engineers, the next highest percentages were 8.8 in public utilities and 8.1 in personal service, and for mechanical engineers 9.9 in personal service, 8.7 in construction, and 8.4 in public utilities. With reference to the distribution, by functional classification, of the 682 industrial engineers reporting, 33.6 per cent were in operation, 27.4 per cent were in general administration and management, and 13.5 per cent were in design and research. Of the 8,764 mechanical engineers, the highest percentage, 33.8, was in design and research, while 25.9 per cent were in operation, 9.6 in construction, and 8.8 in administration.

Naturally, the highest percentage of mining and metallurgical engineers is in extractive industries, where 47.3 per cent were employed, although it is interesting to note that no less than 27.7 per cent reported manufacturing as their field of activity. The next two highest were 11 per cent each for personal service and government work. As for the distribution by functional classification, the highest percentage appears in operation with 43.4, followed by design and research with 19.4. Consultation occupies 11.2 per cent.

When all engineers reporting the field of activity are considered, the order of distribution is as follows: 30.4 per cent in manufacturing, 31.5 per cent in government work, 11.8 per cent in public utilities, 9.6 per cent in construction, 8.1 per cent in personal services, and 5.1 per cent in extractive industries. For functional classification, design and research is first with 26.6 per cent, operation with 24.2 per cent, construction with 24.1 per cent, general administration and management with 8.3 per cent, consulting with 6.4 per cent, teaching with 5.9 per cent, and sales with 4.5 per cent.

The import of this analysis is that there are certain well-defined fields of activity for each of the professional classes. In the case of agricultural and civil engineers it is obviously government work. Architectural engineers are fairly well divided between construction and government work; ceramic, chemical, industrial, and mechanical engineers are largely concentrated in manufacturing; electrical engineers are found mostly in public utilities and manufacturing; and mining and metallurgical engineers appear mostly in the extractive, industrial, and manufacturing zones. For each of the professional classes the outstanding functional classifications are design and research, construction, and operation.

CLASSIFICATIONS OF ENGINEERS, FROM THE QUESTIONNAIRE SENT OUT BY THE U. S. BUREAU OF LABOR STATISTICS

CLASSIFICATION I—INDUSTRY, SERVICE, OR ZONE OF INTEREST

(To Help in Answering Question 12)

A. CONSTRUCTION such as—
- Agriculture
- Airport
- Bridges
- Buildings
- Communication
- Heating
- Highways
- Mapping
- Military
- Power
- Railroad
- Reclamation
- Refrigeration
- Regional planning
- Sewerage
- Surveying
- Tunnels
- Ventilation
- Waterways
- Water works
- General construction

B. EXTRACTIVE INDUSTRIES such as—
- Coal
- Copper
- Iron and steel
- Gold and silver
- Lead and zinc
- Other metals
- Oil and gas
- Nonmetallic minerals

C. PUBLIC UTILITIES such as—
- Electric light and power
- Gas
- Steam
- Cable
- Radio
- Telegraph
- Telephone

D. TRANSPORTATION INDUSTRIES such as—
- Steam railroad
- Electric railway
- Water-borne
- Automotive
- Aeronautical
- Pipe line

E. MANUFACTURING INDUSTRIES such as—

IRON AND STEEL:
Machinery, machine tools, vehicles, shipbuilding, aircraft, ordnance, etc.

ELECTRICAL MANUFACTURING:
Power equipment, transmission equipment, motors, lighting, heating, instruments, appliances, etc.

NONFERROUS METAL WORKING:
Copper and alloys, enamelware, etc.

CHEMICAL AND ALLIED INDUSTRIES:
Charcoal and coke, explosives, paint and varnish, petroleum refineries and products, soap and other chemical products, paper and paper products etc.

TEXTILES, CLOTHING, BOOTS, AND SHOES:
Yarn and cloth manufacture (cotton, wool, silk, rayon, and other fibers), printing and dyeing, garment manufacturing and other textile products, shoe factories, leather products, etc.

LUMBER AND FURNITURE:
Lumbering, sawing and planing mills, wood product manufactories, etc.

FOOD, DRUG, BEVERAGE, AND TOBACCO INDUSTRIES:
Canning, flour milling, meat packing, sugar refining, other food products, distilleries, breweries, tobacco factories, etc.

CLAY, GLASS, TILE, AND STONE INDUSTRIES:
Brick, lime and cement, potteries, glass works, etc.

F. PERSONAL SERVICE such as—
- Education
- Publications
- Professional and trade organizations
- Real estate
- Banking
- Insurance
- Wholesale and retail establishments

G. AGRICULTURE AND FORESTRY

CLASSIFICATION II—FUNCTIONAL CLASSIFICATION

(To Help in Answering Question 13)

A. DESIGN AND RESEARCH
Including supervision and administration of Design or Research.
Also include here Exploration, etc.

B. CONSTRUCTION
Including supervision and administration of Construction.

C. OPERATION
Including supervision and administration of Operation.
Also include here Production, Maintenance, Testing Chemical Analysis and Control, Inspection, etc.

D. CONSULTING
Including Investigation, Production, Valuation, Appraisal, Arbitration, Testimony, etc.

E. TEACHING
Includingsupervision and administration of Education as Deans, Editors, etc.

F. SALES
Including supervision and administration of Sales.

G. GENERAL ADMINISTRATION AND MANAGEMENT
Including Financial Planning, Organization, Promotion, Efficiency, etc.
Indicate this classification only if not principally or directly supervising or administering one of the other classifications listed above.

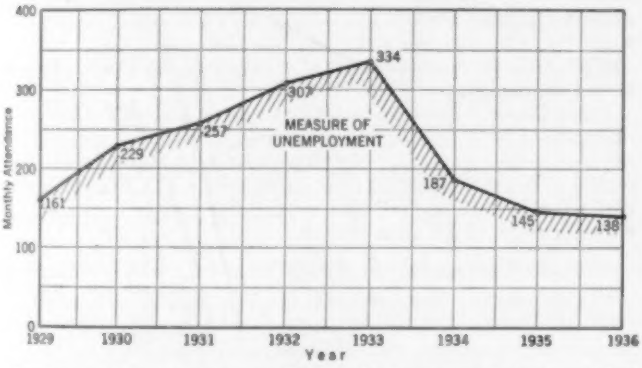
Employment Barometer

Attendance in the Society's Reading Room at Headquarters seems to be decreasing. But this is a matter for congratulation rather than regret since it betokens a busier membership. At least, that appears to be the most logical explanation.

No pains have been spared to make the Reading Room attractive in every way to the member with an hour or two of spare time on his hands. Easy chairs and desks with writing facilities are provided. The lighting is soft and pleasing. The quiet and comfort of the room encourage relaxation and invite to profitable reading. From the walls the faces of all the Past-Presidents look down, giving a family atmosphere to the place. Many members avail themselves of the several hundred periodicals and magazines that are provided. These are of many types—travel, popular, and humorous, as well as engineering. Current newspapers are also available, and the shelves contain many standard books on engineering subjects.

Over 250 Periodicals Are on File at the Reading Room

As a matter of course, a register is kept and all of those who use the room are requested to sign it. Members and non-members are welcome. This register is frequently helpful in determining the addresses of out-of-town visitors. It is also valuable as a gage of the usefulness of the Reading Room itself. The records have been kept for years back, and the totals of attendance are given regularly in the annual report.



Number of Visitors to the Society's Reading Room for May of Each Year, 1929–1936

Recently another use for these data has been found. It is always hard to interpret variations in attendance, but the usual explanation is that it must be directly proportional to the leisure of members. By the same token it would be inversely proportional to the degree of employment. If this view is accepted as reasonable, then the variation over a series of years would indicate the employment trend.

In the accompanying diagram the record for a single month—that for May—has been charted for eight consecutive years. It indicates that the greatest popularity of the Reading Room, and presumably the deepest depths of the depression as far as employment is concerned, was in 1932 and 1933. Since that time a marked improvement has been evident. In fact, 1934 was almost on a par with 1929, whereas each succeeding year has shown further improvement. It is notable that both 1935 and 1936 showed lower attendance in the Reading Room than 1929. If this is a true gage, it appears that the Society's members are busier today than they have been for seven years past. To those who are familiar with employment conditions from other angles, this conclusion seems reasonable enough.

Detroit Engineers Give Vocational Guidance to High School Students

For the benefit of high school students contemplating the study of engineering, the Associated Technical Societies of Detroit recently held its first annual guidance meeting at which 123 boys and their parents were given an opportunity to consult representatives of various branches of the engineering profession. The conference was an outgrowth of the activities of the Committee on Student Selection and Guidance of the Engineers' Council for Professional Development (E.C.P.D.) and was typical of the guidance meetings which E.C.P.D. is promoting in other areas through local associations of engineers.

The conspicuous success of the meeting was due to careful advance planning by the Associated Technical Societies, the hearty cooperation of its twelve constituent groups, and the support of the Detroit Board of Education. The first step was to stimulate interest in the project among the technical societies of Detroit and obtain from them the names of counselors who would participate in the guidance undertaking. At the same time a representative of the Board of Education explained the project to the public school authorities and secured their assistance and support. At a dinner meeting of representatives of all interested groups, the general purposes of the Engineers' Council for Professional Development were explained, particularly the aims of the Committee on Student Selection and Guidance. Counseling groups were organized and instructed, and final plans were laid for the meeting with high school students and their parents.

This meeting was attended by 220 people, including 123 boys. The presiding officer was E. A. Danse, chief metallurgist of the Cadillac Motor Car Company, who has had long experience in work with boys, and who effectively explained the purposes and plan of the meeting. Copies of *Engineering—a Career, a Culture,* a pamphlet distributed by E.C.P.D., were given to all boys present.

The principal address was given by C. F. Hirshfeld, chief of research of the Detroit Edison Company and a past chairman of E.C.P.D. He distinguished between the fields of engineering—such as mechanical and electrical—and the allied professions on the one hand, and on the other, functional activities such as design, research, and sales, which are common to engineering and the allied professions in general, leaving detailed consideration of professional divisions to take place in the conferences.

Following Mr. Hirshfeld's address, all present adjourned to the separate conference rooms assigned to the various societies. In these rooms, counselors of the societies met with those students who were interested in the corresponding professional divisions. These conferences were well attended except in the case of one or two professional divisions in which local numbers are small. The procedure in the various conference rooms was for the chairman or some of his associates, or both, to address the students briefly in explanation of their division of the profession. Thereupon students from the group asked questions, which were answered by the counselor in the room best qualified by experience and training to supply the requested information. Personal and private interviews between counselors and students followed.

Local engineering groups in other parts of the country desirous of undertaking a guidance project can get further details on the Detroit meeting from Dean C. J. Freund, University of Detroit, Detroit, Mich. General instructions and assistance should be obtained from R. L. Sackett, M. Am. Soc. C.E., Dean of Engineering, Pennsylvania State College, State College, Pa., who is chairman of the Committee on Student Selection and Guidance of E.C.P.D.

Appointments of Society Representatives

R. C. Young, M. Am. Soc. C.E., will represent the Society at the inauguration of Grover C. Dillman, M. Am. Soc. C.E., as president of the Michigan College of Mining and Technology at Houghton, Mich., on August 6.

L. F. Harza and William S. Monroe, Members Am. Soc. C.E., have been appointed to represent the Society at the Third World Power Conference, to be held in Washington, D.C., September 7–12, 1936.

F. Vogt, Assoc. M. Am. Soc. C.E., has accepted an appointment as Society delegate to the International Congress of Mathematicians to be held at Oslo, Norway, July 13–18, 1936.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies Located in 40 States

Upstream Engineering Conference Planned

In a letter recently written to Secretary Wallace, appointing a committee to handle an Upstream Engineering Conference, President Roosevelt said: "There are indications that a substantial body of technical information on the control of little waters is now available in the scattered records of American experience—federal, state, and professional. The urgent problem is to bring these data together into a coordinated body of engineering knowledge so that public officials and engineers may have a more definite picture of upstream engineering as an important field of public and professional activity."

"Upstream engineering will have a major part in the efforts to save the land and control floods, and for that reason it offers a broad field of opportunity for the engineering profession. I am, therefore, in hearty accord with an open conference...... I am appointing Messrs. Hugh H. Bennett, chief of the Soil Conservation Service of the Department of Agriculture, Morris L. Cooke, administrator of the Rural Electrification Administration, and F. A. Silcox, chief of the Forest Service of the Department of Agriculture," a committee of three to organize and promote the conference.

The Upstream Engineering Conference is scheduled to consolidate available public and private engineering information on these several related problems and pertinent techniques. It seeks to emphasize prevention engineering with reference to the development and control of water resources and land conservation and use. Counteraction engineering on downstream work may be the secondary consideration, but the engineers who harness the waters of large streams also know about precipitation, runoff, and little waters, and out of their records of observation and experience must come the practical knowledge for immediate use.

Activities of Government Agencies

The Bureau of Labor Statistics is completing the first all-inclusive survey of the engineering profession. The June issue of the *Monthly Labor Review*, published by the Bureau, carried the first official release under the title, "Education and Training."* Other interesting results of the survey will be reported serially in subsequent issues of the *Monthly Labor Review* and finally published for distribution through the Government Printing Office.

The Bureau of Public Roads released the information in June that gasoline taxes in the United States for 1935 amounted to $619,000,000, averaging 3.8 cents on more than 16 billion gallons. Every state in the Union reported increased consumption. A part of the increase in funds from this source is being used for highway surveys and studies.

Emergency conservation work seems inspiring to the young men in that service. Director Fechner reports that continued enlistment is necessary to fill the vacancies left by men who find jobs in private industry. He says that 145,383 men left CCC service in the 12 months ending May 31, 1936, to accept private employment. In addition to that healthy turnover, they have been able to reduce the enrolment from 500,000 to 350,000, without complaint about the return of the "CCC boys" to their home communities.

The Procurement Division of the Treasury at Seventh and D Streets, S.W., Washington, D.C., announces a permanent display of architectural building materials by producers' associations, open to the public during business hours on the fifth floor of the new building at that address. The exhibit occupies eleven rooms and includes a wide variety of practically all natural and manufactured building materials produced in the United States.

The Public Works Administration reports that nearly 60 per cent of its funds have been used to pay materials manufacturers and that the employment provided in industry far exceeds that of direct employment on the sites. They estimate that amount to be $1,331,500,000. Of this amount 70 per cent is claimed to have been used to meet payrolls in mines, mills, and factories. Secretary Ickes has announced that there would be no change in the established basic policies of PWA with respect to the allotment of $300,000,000 made available by the last Congress. June 16, 1936, was the third anniversary of the Public Works Administration. The program has used $1,000,000,000 a year to employ an estimated total of 2,000,000 people on several thousand projects in almost every community in this country. A recent announcement regarding the selection of tenants for the new Techwood homes slum clearance project in Atlanta, Ga., states that such tenants must be selected from among families of low income now forced to reside under subnormal or slum housing conditions. All others will be barred from living in these new low-cost homes. An income range of such families is now set at from $700 to $1,800, varying with the size of the families. Rentals will range from $16.40 for three-room apartments to $31.30 for the highest priced six-room group house. Utility service will be furnished at cost.

Rural Electrification Administration loans are being accepted at a surprisingly rapid rate by cooperatives and a few utilities. REA is now active in 35 states and has loans and allocations approximating $15,000,000 for the construction of more than 15,000 miles of lines to serve over 50,000 new customers in rural areas. REA launched a new phase of its program on June 18, 1936, when it began making loans to cooperatives to be reloaned to customers to pay for wiring farmsteads and the installation of equipment and appliances. Such loans may now be made by cooperatives up to 80 per cent of the cost of wiring and installation and may be repaid over periods up to five years in equal semiannual installments with 3 per cent interest on the unpaid balance. In announcing the availability of reloan privileges, Administrator Morris L. Cooke has emphasized the requirement that all plans and specifications must call for first-class materials and workmanship and should make adequate provision for future expansion to permit the addition of new electrical appliances.

The Securities and Exchange Commission's report for April showed a spurt in activities of interest to engineers: 68 issuers of securities were industrial or commercial corporations offering $605,700,000. The activity was not fully sustained in May but it reflects sustained constructive action in heavy and durable goods industries, which engineers in those lines welcome. SEC news for this month is the announcement of the reappointment of Chairman James M. Landis.

Social Security faces the enormous task of getting employer cooperation in recording pertinent data on 26,000,000 persons for the old age benefits program. Employers are asked for earnings, and personal data will be gotten from employees. The set-up is scheduled to include 12 regional and approximately 100 district offices, with personnel under Civil Service.

Engineers Participate in Third World Power Conference

The engineering profession has been assigned a most desirable exhibit space by the Third World Power Conference, all the space around the inside of the east entrance to the main promenade of the Mayflower Hotel. Enlarged emblems and colorful panels carrying the names of all engineering organizations and sections of the Founder Societies will invite attention to the proportions of organized engineering. The location of each organization will be indicated on large mounted maps of the states, and a series of graphic displays will outline activities of the several instrumentalities.

A personal greeting will be extended to all delegates by an Engineers' World Power Conference Committee and members of the staff of American Engineering Council, who will be in attendance to welcome engineers from other countries and to help them make desirable contacts and to otherwise enjoy their visit to the United States.

Engineering Employment Situation

It is significant that the New England Council has just issued a special release urging New England industry to insure its growth by employing graduates of technical schools and colleges and utilizing their cooperation in research programs. That practice is urged as a guarantee against obsolescence.

Now that the Soil Conservation Service has "a permanent status," it offers more attractive opportunities for men and women whose lives are conscientiously devoted to the sciences. The Service was one of the largest employers of engineers among the emergency agencies.

Road building and improvement is a part of almost every pro-

* Editor's Note: An abstract of the release appears elsewhere in this issue.

gram of the emergency agencies. It is being done in every state and extends into the most remote communities. Engineers with experience fitting them for that work who seek positions in government service should check all activities of the municipal, county, state, and federal agencies for opportunities, and contact the nearest offices of the emergency agencies.

Although there is much talk about it, no really important changes have been made in the several public works programs, and while new opportunities for engineers are limited, it seems likely that most of the engineers now in government service may remain through this fiscal year although some may be transferred from one program to another.

Activities of Council

The committee on consumption, production, and distribution is revising its current report and preparing it for consideration by member organizations prior to release and publication. The public affairs committee of 1935 has completed its review of legislation and executive orders supporting the National Resources Committee with the recommendation that AEC take no action, at this time, regarding the permanent establishment of the National Resources Committee. Publicity committees for the profession and for American Engineering Council are interesting all engineering and functional organizations in the engineers' exhibition and souvenir brochure on engineering organizations in the United States for the information of the delegates to the Third World Power Conference. The committee on the engineers' survey is reviewing the releases of the Bureau of Labor Statistics preparatory to making recommendations regarding the practical use of the results of that survey. Council is happy to announce the first of a series of publications outlining the objectives, facilities, and accomplishments of American Engineering Council as an organization of engineering organizations.

Washington, D.C.
July 15, 1936

Field Secretary Visits Local Sections and Student Chapters

Early in 1935 the Society's Committee on Aims and Activities recommended, and the Board of Direction authorized, the creation of a new position on the Headquarters staff, that of Field Secretary, and Walter E. Jessup, M. Am. Soc. C.E., was designated to fill it. He had been editor of Civil Engineering for the previous five years.

In the past fourteen months the Field Secretary has been circulating almost continuously among the members of the Society and of the Student Chapters. Of the 58 Sections it has been possible for him to meet with 54. In addition, he has attended the regional conventions of Local Sections in Indiana and in Ohio, and Local Section conferences during the Society Meetings in Birmingham, Ala., in New York, and in Hot Springs, Ark. Then too, he attended the initial meeting of the Junior Forum of the District of Columbia Section, met with the Association of Junior Engineers of the Colorado Section in Denver, and with the Junior Branch of the Metropolitan Section in New York.

Visits to Student Groups

Of the 113 Student Chapters, 96 have been visited on their "home grounds," so to speak, by attendance at Chapter meetings, in addition to the regional Student Chapter conventions which were held during the past year in Philadelphia, in Virginia, in North Carolina, in Ohio, and in Indiana; and the Society-sponsored Student Chapter conferences in New York, Birmingham, Ala., and Hot Springs, Ark. In this way he has made contacts with representatives of all but seven of the Society's student organizations.

To follow the path of the Field Secretary would take one into every state of the Union and would require nearly 50,000 miles of travel. Figure 1 shows the location of most of the 230 meetings he has attended since the middle of March 1935.

The Board of Direction, in authorizing the appointment of a Field Secretary, had the desire that the Society should be alert to the problems of registration; alert to the breakdown which is occurring in Civil Service; to the extent to which the civil engineering profession is employed; and to the salaries and fees which engineers are obtaining for their services. Perhaps most important of all, it had the desire to gain a more complete understanding of the problems of the Local Sections, how they can become more effective or what assistance they may desire from Society Headquarters.

One of the subjects most often under consideration in discussions between members of Local Sections and the Field Secretary has been the desirability of increasing the Society's usefulness to the individual member of the profession without in any way diminishing its efforts on behalf of the profession as a whole. As a step in this direction a considerable number are of the opinion that the scope of the work being done by the Local Sections should be extended and expanded to serve every member of the Society.

Importance of Affiliation with a Local Section

In his annual address discussing the development of the Society, presented in July 1935 to the Los Angeles Convention, Past-President Arthur S. Tuttle suggested that it was desirable, "First, to provide for definitely assigning each member of our Society residing in the United States or any of its major possessions, or in Canada, to a Local Section, with provision for at least one such Section in each state or major possession; and second, to secure unity of action on the part of Local Sections in matters of state concern in case there is more than one Section in a state." He expressed the hope that, as interest in forming new Sections is stimulated, and in order to maintain a high professional standing in those now existing, the Society could assume a generous share of the financial burden of supporting their activities.

Plans are being considered by the Society's Committee on Local Sections by which every member in good standing in the Society will be able to participate in all its activities without additional financial obligation. These proposals involve the assignment by the Board of Direction of every member of the Society in the United States and its possessions to a Local Section and encouragement and stimulation of new Sections in states and communities where none now exist. An effort is being made to work out the details of a suitable plan.

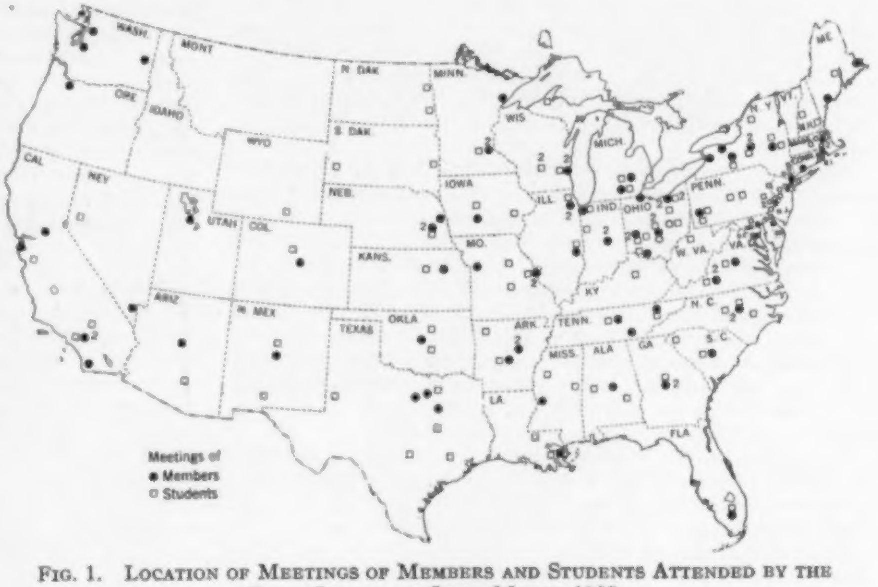


Fig. 1. Location of Meetings of Members and Students Attended by the Field Secretary Since March 1935

Syracuse Section Favors Licensed Engineers in PWA Positions

AT A REGULAR MEETING of the Syracuse Section of the Society held April 16, 1936, a resolution was adopted urging upon officers having jurisdiction and appointive powers, the naming of duly licensed professional engineers to administrative engineering positions. The text of the resolution follows:

"WHEREAS, the Works Progress Administration is engaged in engineering work; and

"WHEREAS, it is requisite that the heads of engineering departments be licensed professional engineers; therefore be it

"*Resolved* that the Syracuse Section of the American Society of Civil Engineers goes on record as favoring the appointment of duly licensed professional engineers to positions as heads of engineering departments; and be it further

"*Resolved* that the secretary of this organization be directed to forward copies of this resolution to such persons, agencies, and administrators as have jurisdiction and appointive power in work relief activities and projects."

Engineering Foundation Conducts Foundations and Hydraulics Research

AMONG the numerous activities carried on by the Engineering Foundation during the second quarter of 1936, April to June inclusive, were two of special interest to civil engineers. The earths and foundations research projects included investigation of the settlement of existing structures and the holding power of piles and sheeting; studies of earth dams and retaining walls and of the consolidation of clay; and centrifuge and photo-elastic studies of structures and earthy materials. Under the head of hydraulic research, the Foundation has stated the problems and selected the researchers and laboratories for (1) the conversion of kinetic to potential energy, (2) traveling waves on steep slopes, (3) phenomena of intersecting streams, (4) curves in open channels, and (5) sedimentation at the confluence of rivers.

The Engineering Foundation is the joint endowed organization of the Founder Societies for research and closely related activities. While the Foundation regards engineering research broadly interpreted as the preferred field for its activities, its operations are not restricted to that field.

In and About the Society

"ENGINEERS are often geniuses who dream graphic charts into the substance of empire," says the *Oregon Journal*, commenting editorially on the recently published Memoir of D. C. Henny, M. Am. Soc. C.E. Too often, perhaps, one is inclined to pass over the Memoirs as uninteresting or unimportant. But as a record of men who have had a part in building the "substance of empire," should they not be considered as documents of true historic significance? The *Journal*, apparently, regards them in that light.

* * * *

TO THE LIST of Society Members recorded in the June issue as holding important assignments in the preparation of the National Resources Committee's water plan should be added the names of Donald M. Baker and Howard T. Critchlow, respectively western and eastern regional coordinator, and Brent S. Drane, in charge of compilation of the existing data.

Preview of Proceedings

By HAROLD T. LARSEN, *Editor*

Two papers in the field of structures will inaugurate the autumn season of discussion in "Proceedings." After two months of recess, during which Volume 101 of "Transactions" has been in preparation, the August issue of "Proceedings" will appear according to schedule, on August 15, with one paper on Vierendeel trusses and one on the solution of simultaneous equations.

ANALYSIS OF VIERENDEEL TRUSSES

THE ANALYSIS of Vierendeel-type trusses presents many interesting problems to the structural engineer. One method of analyzing such structures is presented by Dana Young, Assoc. M. Am. Soc. C.E., in a paper entitled, "Analysis of Vierendeel Trusses." The method is a modification of the system developed by Prof. Arthur Vierendeel of the University of Louvain and used in the design of many bridges.

The solution presented in this paper is based on the principle of virtual work. Two general forms of trusses are treated. The first class includes trusses with parallel chords and trusses with equally inclined chords such as are used for rigid viaduct bents. For these types the analysis is relatively simple and is "exact"—that is, no more assumptions are involved than those inherent in the fundamental theory. The second class of structure considered covers trusses with curved upper chords and horizontal lower chords such as those used for bowstring bridges. The analysis for this type is more difficult and involves certain assumptions, but gives results which are sufficiently accurate for good design. Examples for each type of truss are worked out in detail.

The analysis developed in this paper is general in form and is not intended to be a short-cut method. However, the author points out how various modifications of the method may be made so as to obtain a very simple and yet reasonably accurate solution.

There is a surprising lack of material available in the United States concerning Vierendeel trusses. Mr. Young's work is authoritative since he has studied the subject as a specialist for a number of years and, in the preparation of this paper, has the active encouragement and assistance of Professor Vierendeel himself, who furnished complete detailed drawings and original photographs of a number of bridges designed by him. The scope of this paper is limited to stress analysis, and the author has succeeded in making his presentation brief and concise without sacrificing clarity.

SIMULTANEOUS EQUATIONS IN MECHANICS SOLVED BY ITERATION

The application of successive approximations in the solution of simultaneous equations is demonstrated by W. L. Schwalbe, assistant professor of theoretical and applied mechanics at the University of Illinois, in a paper entitled, "Simultaneous Equations in Mathematics Solved by Iteration." In this paper the method of iteration is applied to equations of three moments, equations of three angles, and equations of five angles, all of which occur in structural mechanics. The first two occur in the theory of continuous beams, and the equation of five angles occurs in the theory of continuous frames. The complete paper is fairly brief, well-arranged, and concise. A selected brief bibliography of a single page constitutes Appendix 1; the derivation of mathematical formulas which is not absolutely essential to an understanding of the text matter, but valuable to those who wish to examine the theory in detail, has been included as Appendix 2; and finally, for the convenience of readers (and particularly of discussers, who are requested to adopt the nomenclature used by the author), a notation is included as Appendix 3 in this paper.

MAIL DISCUSSIONS PROMPTLY

Writers are urged, in their own best interests, not to procrastinate in their intention to discuss a PROCEEDINGS paper, especially in the next few months. In the August and September issues of PROCEEDINGS the space allotted to papers will be relatively brief, and to discussions relatively great, in order that the October number of PROCEEDINGS may be given over entirely to the publication of a noteworthy symposium on "Structural Application of Steel and Light Weight Alloys." Since there will be no room available for discussion in the October issue all the discussions arriving too late for September will, perforce, be held over until the November issue of PROCEEDINGS. Every effort will be made to get all current discussions in print, but to do so, it will be necessary to depend on the willingness of contributors to sit down promptly and write their discussions.

News of Local Sections

Colorado Section

The June meeting of the Colorado Section was held at Fort Collins, Colo., on the 27th. At this time the new hydraulic laboratory on the campus of Colorado State College was dedicated. The welcoming address was given by Dr. Charles A. Lory, president of the college. This was followed by brief comments by E. P. Sandsten, director of the Colorado Agricultural Experiment Station; S. H. McCrory, chief of the Bureau of Agricultural Engineering, Washington, D.C.; W. W. McLaughlin, chief of the Division of Irrigation, Bureau of Agricultural Engineering, Berkeley, Calif.; and R. F. Walter, chief engineer of the U. S. Bureau of Reclamation, Denver, Colo. M. C. Hinderlider, state engineer of Colorado, gave the principal address of the occasion. At the conclusion of the speeches the ladies were entertained in Ammons Hall, while the men inspected the hydraulic laboratory. This entertainment was followed by a banquet in the college cafeteria. R. L. Parshall was chairman of the committee in charge of arrangements. A brief description of the laboratory appears in the "Items of Interest" department of this issue.

Florida Section

Members of the Florida Section enjoyed a luncheon meeting held at the Floridan Hotel in Tampa on April 1. Among the guests on this occasion were distinguished engineers from several states. On April 2 and 3 the official meeting of the Section took place at Daytona Beach in conjunction with a meeting of the Florida Engineering Society. The technical sessions were devoted to a discussion of the Gulf-Atlantic ship canal.

Georgia Section

A meeting of the Georgia Section was held in Atlanta on May 11. Several announcements were read, and then the speaker of the occasion, E. Rivers, of Lakeland, Ga., was introduced. Mr. Rivers, who was speaker of the Georgia House of Representatives last term, is now a candidate for governor. In his talk he emphasized the fact that the future of the state is at stake in the present contest between progressive and reactionary forces. He illustrated his talk with comments on recent state legislation.

Los Angeles Section

The annual field day of the Los Angeles Section, held at the Altadena Golf Club on the afternoon and evening of June 27, was advertised as "a chance for engineers to be human." The afternoon was devoted to a variety of sports, and there was a dinner in the evening. The after-dinner program took the form of a theatrical entertainment consisting of several musical and novelty acts.

Philadelphia Section

The annual meeting of the Philadelphia Section, held on June 17, concluded a season of interesting and worth-while meetings. There were 34 members and guests present at the dinner, and 45 at the meeting following it. The chairman and first speaker was Alan Corson, chief engineer of the Fairmount Park Commission, who described the establishment and growth of that park. Samuel M. Baxter, arboriculturist of the commission, spoke of the many small parks in various parts of Philadelphia that are under the commission's jurisdiction. Then W. W. Chambers showed five reels of beautiful motion pictures of the park, the zoological gardens, and the Wissahickon Creek. Following the addresses, the report of the tellers on the election of officers for the 1936–1937 term was presented. The new officers are: Berthold F. Hastings, president; William E. A. Doherty, vice-president; and Harry W. Freeburn and John C. H. Lee, directors.

Portland (Ore.) Section

A joint meeting of the Portland (Ore.) Section and the Oregon State College Student Chapter was held at Corvallis on May 16, the occasion being the annual engineers' day at the college. The speakers on this occasion were H. A. Rands, senior engineer for the U. S. Engineers at Eugene, Ore., and C. A. Mockmore, head of the department of civil engineering at the college. The winning paper in the annual Student Chapter contest was also read. The June meeting of the Section was held at the University Club on the 19th, with 36 present. At this session Norman F. Coleman, of Reed College, discussed the topic, "Our Pacific Neighbors." In his talk Dr. Coleman, who has been a frequent visitor to the Orient, commented primarily on Japanese and American economic and military relationships, describing the activities of the U. S. Navy in the Pacific during recent years and their effect upon the Japanese. An animated discussion followed, after which the meeting was turned over to a discussion of the program and plans for the Annual Convention.

Providence Section

At the annual meeting of the Providence Section, held on June 11, the following officers were reelected for the coming year: Warren G. Baxter, chairman; William R. Benford, vice-chairman; and Frederick H. Paulson, secretary-treasurer. Following the election, a talk was given by Walter E. Jessup, Field Secretary of the Society. Mr. Jessup gave an interesting discussion of the problems confronting Local Sections and the steps being taken by the Society to solve these problems.

Sacramento Section

The Sacramento Section continued to hold its weekly luncheon meetings during May. On the 12th the speaker was J. Burdette Brown, extension specialist in irrigation at the College of Agriculture of the University of California. On May 16 an inspection trip to view the work on the Golden Gate Bridge was made by 125 members of the Section and their friends. The builders of the bridge had assigned a number of their engineers to accompany the party and explain the work, so the trip proved both interesting and instructive. At the meeting held on May 19 the speaker was Earle Lee Kelly, director of public works of the state, who outlined the work and accomplishments of the various state divisions under the jurisdiction of the public-works department. May 26 was designated "Junior Day," as Juniors of the Section were in charge of the meeting and the program. The speaker was Glenn L. Enke, associate bridge designing engineer for the State Department of Public Works.

San Diego Section

The June dinner meeting of the San Diego Section was held at Vincent's Cafe on June 25, with 20 present. After a short business meeting the speaker, Fred D. Pyle, city hydraulic engineer, was introduced. Mr. Pyle outlined the past, present, and future of the water situation in San Diego and San Diego County. From the arrival of the first white men there has been a water supply problem in this part of the country. After describing the present distribution system, which includes El Capitan Dam, one of the highest rockfill dams in existence, Mr. Pyle suggested improvements that could be made to advantage in certain dams. An animated discussion followed.

San Francisco Section

At the regular meeting of the San Francisco Section, held at the Engineers' Club on June 16, E. I. Kotok, director of the California Forest and Range Experiment Station, gave a talk on the "Watershed Problem from the Forester's Point of View." Mr. Kotok described the large-scale investigation now under way at the San Dimas experiment station in southern California. This talk, which was illustrated, proved very instructive and interesting. There were 90 members and guests at the dinner and business meeting preceding the technical session.

Seattle Section

On June 29 members of the Seattle Section met for dinner and their regular monthly meeting. After a brief business session, a talk was given by Lt. Commander Otis William Swainson, hydrographic and geodetic engineer, U. S. Coast and Geodetic Survey. His topic was "Under-Sea Topography and Mapping the Floor of the Pacific."

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for September

Among the articles scheduled for the September issue of Civil Engineering is one by Enoch R. Needles, M. Am. Soc. C.E., member of the firm of Ash-Howard-Needles and Tammen, on the design and construction of the Harlem River Lift Bridge and the Bronx Kills crossing, integral parts of New York City's newly opened Triborough Bridge. Mr. Needles' consulting firm prepared the designs and supervised erection of both bridges for the Triborough Bridge Authority. In terms of roadway area, the Harlem vertical-lift span is said to be the largest of its type yet built. On May 3, 1936, the span was floated into position between towers and raised first to pier level, where end panels were erected and connections to counterweights made. Roadway floors and sidewalk surfaces were installed with the span at its full height of 135 ft. Contrary to usual practice, the 133.5-ft towers are supported on the piers independently of the side spans. The middle span of the Bronx Kills crossing has been designed for future conversion into a vertical-lift span in the event that the Kills should ever be made navigable.

Pre-college selection of superior students adapted to succeed in engineering study is possible at this time by the use of tests in force at a number of institutions, says Clair V. Mann, M. Am. Soc. C.E., head of the engineering drawing department at the Missouri School of Mines, in an article on the systematic selection and guidance of engineering students. The information obtained by such tests at the Missouri School of Mines is compiled in a "personograph," which shows on a single polar chart all the measured qualities of the individual student, including mental abilities, special abilities, personality ratings, and intensity and diversity of professional interests. Space is also provided on the chart for term-by-term scholastic records. The charts are not only valuable to the engineering faculty in dividing a given class into high-, intermediate-, and low-caliber groups for teaching purposes, but are also of considerable use and interest to the student himself, aiding him in his choice of the proper college course to take and of the best professional field to follow after graduation.

More engineers are in contact with and employed by the various federal government bureaus today than at any previous time, principally in connection with the current public works construction program. A timely article by Maj. Gen. E. M. Markham, M. Am. Soc. C.E., chief of engineers, U. S. Army, on the subject of the engineer in government service, is scheduled for the September number. The duties of the government engineer are outlined in an interesting manner, and a sharp distinction is made between the functions of the engineer and those of the statesman. The construction activities of the Corps of Engineers, representing an expenditure of more than $580,000,000 during the past three years, serve as a background for General Markham's discussion of the principal topic.

If space permits, an article on the subject of beach erosion in Southern California by the late C. M. Cram, M. Am. Soc. C.E., former harbor and marine engineer on the west coast will be included in the September issue. The chief sources of sand along the lower California coast are rivers. As a result of irrigation and flood control work, says Mr. Cram, the river-borne sand is diminishing in volume, and either human occupation of uplands bordering the coast between certain headlands must eventually be given up, or the present shore must be protected against the encroachment of the sea by artificial works.

Openings for Young Engineers Announced by Navy Department

Opportunity for an interesting and varied engineering career in the Navy is opened to a number of young engineers now in civil life, by the announcement of an examination to fill vacancies in the Navy's Corps of Civil Engineers. Successful applicants will be commissioned with the rank of lieutenant (junior grade).

Officers of the Corps of Civil Engineers are charged with the construction and maintenance of all facilities entering into the "shore establishment" of the Navy, such as dry docks, marine railways, harbor works, power plants and power distributing systems; heating, lighting, telephone, water, sewer, and railroad systems; roads and bridges; and all buildings for whatever purpose required. They are detailed for duty principally at the various navy yards and naval stations in the United States and its possessions, but are subject to assignment anywhere in the world. Sea duty is not contemplated, but there is no legal restriction against it.

Applicants must be citizens of the United States, between 22 and 30 years of age as of January 1, 1937; they must have received an engineering degree from a college of approved standing, and must have had not less than three years practice in engineering prior to June 30, 1936. Two years of this experience must be subsequent to the receipt of their first engineering degree.

Official application blanks can be obtained from the Chief of the Bureau of Yards and Docks, Navy Department, Washington, D.C., and must be completed and returned before September 15, 1936. The information requested on these blanks constitutes a non-assembled examination as to general fitness. Candidates selected on the basis of these reports will be required to take a physical examination, and those who pass both these preliminary hurdles successfully will be admitted to a comprehensive oral and written professional examination beginning about October 15. This final test, it is anticipated, will require about 5 days. It will be held at Washington, D.C., and at such other cities as the number of candidates in the region may justify, such as New York, Chicago, and San Francisco.

An officer of the rank of lieutenant (junior grade) with dependents, when first appointed receives, including allowances, approximately $3,160 per annum; without dependents, including allowances, approximately $2,700 per annum. The base pay is increased every 3 years. While it is impossible to make any definite statements regarding promotion prospects, it is estimated that under normal conditions officers appointed from civil life will be eligible for selection for promotion to the rank of lieutenant after 3 or 4 years and to the rank of lieutenant commander after 12 or 13 years of commissioned service.

Wise and Otherwise

Professor Abercrombie is indebted to *The News*, official organ of the Philadelphia Section, for the following hot-weather problem:

Deep in the jungle, a monkey is pursued by a leopard. The only practicable means of escape seems to be by way of a long liana vine drooping over a high branch. Seizing the near end, the monkey starts to climb at the rate of 4 ft per sec. At the other end of the liana, just resting on the ground, natives had attached a number of cocoanuts, aggregating 10 lb in weight—the exact weight of the monkey. Three seconds after the monkey reaches the vine, the leopard arrives, and immediately leaps after him to a height of exactly 6 ft. If the monkey is out of his reach, the leopard can (allowing 2 sec to crouch and spring) jump to a height of 11 ft at the monkey's end of the vine. Or (allowing $2^1/_2$ sec—the time required for him to think of a more subtle plan) he can go after the cocoanuts. If he seizes the cocoanuts on the other end of the vine, he can, by jerking, break the vine and the monkey will fall into his jaws. Neglecting the weight of the vine and friction between it and the branch, which plan should the leopard follow? Can the leopard catch the monkey? If so, how and when?

Suggestions for other problems for Professor Abercrombie's column, accompanied by solutions, may be addressed to the editor. Solutions should preferably be sent in separate enclosed envelopes.

Triborough Bridge Opened for Traffic

New York City's $60,300,000 Bridge Dedicated July 11, 1936

Erecting the 300-Ft Towers for the Suspension Span, October 1934

Strands in Wards Island Anchorage Saddle, May 1935

Randall's Island Junction from West Toll Plaza, July 1936

The Columns Are to Be Enclosed with Concrete Curtain Walls

Viaduct, Looking North from Wards Island Tower, July 1935

Progress of Floor-Steel Erection, Looking Southwest from Wards Island, October 1935

"Norman" Disaster Recalled by Dedication of Memorial

ON the afternoon of May 8, 1925, the Mississippi River towboat, *M. E. Norman*, was heading upstream for Memphis, Tenn., with an excursion party of engineers and their families aboard. The women were taking their ease on the foredeck; in the cabin the men were discussing the organization of a Local Section of the Society.

Suddenly the *Norman* listed violently to starboard. Bells jangled in the engine room; the wheel stopped. In a moment the craft righted itself and apparently headed for the bank. Another list; signals again to the engine room, but no response. The list increased; a swift current caught the sloping hull, and in a matter of seconds the *Norman* was floating bottom-side up.

Passengers and crew—those who had been able to free themselves from the cabin or the screened-in deck—began to clamber onto the upturned hull. There, it seemed, they would be safe. But as the compartments filled with water the boat rolled slowly to its side, and a moment later went down, stern first, forcing them again into the river.

A quarter of a mile upstream Tom Lee, a Negro, was also bound for Memphis in a power boat. Over his shoulder he saw the *Norman* capsize. Quick as a flash he turned his boat, swung into the current, and with his engine wide open raced back to the scene. But so quickly did the *Norman* go down that when he arrived she was already out of sight. With skill and dispatch he wove his boat into the group of struggling survivors, lent them a hand as they pulled themselves one at a time over the gunwales and, his boat loaded, shot for the shore. Time and again he returned to the channel for another load, until 32 men and women had been landed on the bank.

Others reached safety singly, fighting the treacherous currents with life-preservers or floating pieces of wreckage. But when they had gathered, shivering, about a fire on the shore, they found that the river had claimed 23 of the group. Among the dead were many prominent engineers of the South. Twelve of them were members of the Society—Paul Norcross, a Director; George Lee Anderson, Ralph Bosard, Edmund H. Bowser, Stephenson W. Fox, William M. Gardner, William Hannum, Walter G. Kirkpatrick, Robert H. McNeilly, Charles H. Miller, Charles E. Shearer, and William O. Walker.

Shortly after the disaster one of the survivors, John R. Fordyce, M. Am. Soc. C.E., assembled a fascinating group of letters recounting the personal experiences of others who escaped. It is from these letters that the story as told here has been pieced together. And it would not be complete without the following quotation from one of them: "There were no shrieks, no selfishness; only a cool determination to meet death, if it should come, as men in the profession have been taught to meet it—and with total disregard of self. This experience, so long as I live, will make me proud of belonging to a class of men who can look death in the face and die like gentlemen."

There were many acts of heroism—some of them at the cost of life. Mr. Bowser, for example, went down exhausted after supporting his little nephew in the water until help came. Others, carried away from the rest of the group by the force of the current, were powerless to give active assistance, but played the part of heroes by waving aside the rescue boat until the weaker had been saved.

Among the survivors were the following members of the Society: C. C. Cagle, J. P. Carey, Past-President John F. Coleman, Lt. Col. D. H. Connolly, W. W. DeBerard, J. H. Dorroh, Albert S. Fry, J. H. Haylow, L. L. Hidinger, Alfred M. Lund, Garner W. Miller, C. W. Okey, H. N. Pharr, C. C. Reams, J. R. Rhyne, W. F. Schulz, W. G. Stromquist, and H. A. Wiersema.

On May 11, 1936, a column in commemoration of the disaster was unveiled in the U. S. Engineer Depot, West Memphis, Ark. And on July 20 the Engineers' Club of Memphis, which had been host on the ill-fated excursion, added a bronze plaque with the names of the victims.

THE TOWBOAT *Norman*, WHICH CAPSIZED WITH A LOSS OF 23 LIVES ON MAY 8, 1925, AND A MEMORIAL TO THE VICTIMS
The Monument Was Unveiled on May 11, 1936

Brief Notes from Here and There

THE NEW hydraulic laboratory on the campus of the Colorado State College, at Fort Collins, was dedicated on June 27, 1936. The plant includes a brick and steel building with a floor space of 96 by 119 ft, and a current-meter rating station consisting of a concrete tank 250 ft in length. Funds for the construction were contributed by WPA, the Colorado Experiment Station, the Bureau of Agricultural Engineering, and the State Engineer of Colorado. The original laboratory, with a floor space of 40 by 60 ft, was built in 1912. Since then the Agricultural Experiment Station, in cooperation with the Bureau of Agricultural Engineering, U. S. Department of Agriculture, has used it continuously for experimental and research work on weirs, measuring flumes, sand traps, and other hydraulic devices. Experiments have also been conducted on percolation and evaporation. Since August 1930, the Bureau of Reclamation has occupied the laboratory jointly with the Bureau of Agricultural Engineering, making extensive investigations on models of spillways, penstocks, gate towers, valves, and other hydraulic structures. Hydraulic problems of such major projects as Boulder, Norris Madden, and Grand Coulee dams have been brought to the laboratory for solution.

* * * *

HEADLIGHT GLARE and its attendant hazards may some day be eliminated by the use of polarized light. The Highway

Research Board of the National Research Council reports a suggestion that all cars be equipped with headlight lenses and windshields arranged to polarize light along an axis at 45 deg with the vertical. "As the axes of polarization of the headlight and of the plate (or analyzer) through which the driver looks are parallel, the road and objects ahead will be illuminated as usual, but when a car similarly equipped approaches from the other direction the axes of polarization of the drivers' analyzers and the approaching headlights will be at 90 deg with each other and the drivers will see practically nothing of the opposing headlights, although their own lamps will light up the way ahead and the approaching car."

Additional Honorary Degrees

SINCE the July issue of CIVIL ENGINEERING went to press, word has reached Society Headquarters of other members awarded honorary degrees during the past commencement season. These are as follows:

WILLARD T. CHEVALIER, M. Am. Soc. C.E., doctor of science, Colorado School of Mines.

WILLIAM ROBERT KALES, M. Am. Soc. C.E., doctor of laws, Wayne University (Detroit).

ALEXANDER POTTER, M. Am. Soc. C.E., doctor of engineering, Lehigh University, June 9.

L. D. RICKETTS, M. Am. Soc. C.E., doctor of engineering, Rensselaer Polytechnic Institute, June 13.

NEWS OF ENGINEERS

Personal Items About Society Members

C. E. MYERS, consulting engineer of Philadelphia, Pa., has been reappointed a member of the Pennsylvania State Registration Board for Professional Engineers for a six-year term. This nomination, which was made by Governor Earle, has now been confirmed by the State Senate.

NATHANIEL A. CARLE, consulting engineer for the Puget Sound Bridge and Dredging Company, was recently appointed city engineer of Seattle, Wash.

RICHARD R. LUKENS, commander, U. S. Coast and Geodetic Survey, has been transferred from Washington, D.C., to San Francisco, Calif., where he will be in charge of the local office of the Survey.

FRANK M. KELLER, of Denver, Colo., has been appointed engineer inspector for the Public Works Administration in Colorado, Utah, and Wyoming.

EDWIN W. KRAMER has accepted a position as regional director for the Federal Power Commission in San Francisco, Calif. He was previously with the U. S. Forest Service in the same city.

BYRON BIRD is now associate consultant of the National Resources Committee, with headquarters in St. Louis, Mo.

JAMES S. LEWIS, JR., who was formerly in charge of foundation treatment for the Tennessee Valley Authority at Norris Dam, has been transferred to Chattanooga as assistant construction superintendent at Chickamauga Dam.

ERNEST A. CAPELLE is now technical salesman for the Taylor Instrument Company at Rochester, N.Y. Previously he was cultural foreman for the State Park Division of the National Park Service at Castile, N.Y.

JOHN E. RINNE, formerly with Walter L. Huber, of San Francisco, Calif., is now resident engineer on the construction of two overhead storage tanks and a filtered water reservoir for the city of Sacramento, Calif.

EUGENE A. HARDIN has resigned his position with Black and Veatch, of Kansas City, Mo., to join the staff of the Detroit (Mich.) sewage disposal project.

WALTER STARKWEATHER, civil engineer of Detroit, Mich., has accepted a temporary position as technical assistant engineer to the chief civil engineer of the U. S. Coast Guard at Coast Guard Headquarters, Washington, D.C.

GEORGE J. VIERTEL recently became superintendent of construction for the Lockwood Management Corporation of New York City. He was previously with M. Shapiro and Son, engineers and contractors of that city.

GEORGE D. BURR, formerly with the Hetch Hetchy Water Supply of San Francisco, Calif., is now structural engineer in the Bureau of Engineering of the Public Utilities Commission of the same city.

JOHN R. MAHER, SR., who is ECW regional administrator for the U. S. Soil Conservation Service, has his headquarters at Des Moines, Iowa.

LYNDON F. KIRKLEY, associated with the fabricated steel construction division of the Bethlehem Steel Company, has been transferred from Bethlehem, Pa., to San Francisco, Calif., as junior engineer on the erection of the floor system of the Golden Gate Bridge.

FRED M. BROWN, formerly resident engineer for the State Highway Commission at Bozeman, Mont., is now acting division engineer for the same organization.

GUY R. SCOTT has been made sanitary engineer of the health and medical division of the Tennessee Valley Authority at Knoxville, Tenn. Previously he was in the general engineering and geology division of this organization.

JULIUS L. SPEERT has been promoted from the position of junior topographic engineer for the U. S. Geological Survey, Washington, D.C., to that of assistant topographic engineer.

L. ROY BOWEN is at present supervising architect of Eleemosynary Institutions, Bi-Partisan Advisory Board of the State Building Commission (Missouri), on the design and construction of state hospitals. His headquarters are at Jefferson City, Mo.

MORRIS ATKIN is landscape foreman for the New Jersey Emergency Conservation Work of the National Park Service at Sussex, N.J.

EDWARD R. CARY, professor of geodesy and railroad engineering at Rensselaer Polytechnic Institute, Troy, N.Y., who has been a member of the faculty there for the past 48 years, will retire on September 15.

B. O. CHILDS, formerly drainage engineer for the Bureau of Agricultural Engineering of the U. S. Department of Agriculture at Alexandria, La., has been transferred to the district engineer's office of the Bureau at Lafayette, La.

GEORGE LANGSNER has resigned as junior bridge construction engineer for the California Division of Highways to become junior road engineer for the Mission Agency of the U. S. Indian Service at Riverside, Calif.

PAUL HALL, who is with the Austin Bridge Company of Dallas, Tex., has been transferred to Galveston, where he will remain for about two years in the capacity of job engineer on the Galveston Bay causeway project.

ALFRED AFRICANO is joint recipient, with the American Rocket Society, of the Rep-Rirsch Prize of 5,000 francs, awarded by the Astronomical Society of France for his outstanding work on rocket-design formulas. This is the first time the prize has been awarded to an American.

NEIL VAN EENAM has resigned his position with the Michigan Central Railroad Company to become associate bridge engineer with the U. S. Bureau of Public Roads in Washington, D.C.

JOHN C. TRACY, who has been a member of the civil engineering faculty of Yale University for the past forty-five years, retired on July 1, as professor of civil engineering emeritus.

HERMAN SCHNEIDER, dean and president emeritus of the University of Cincinnati, was recently awarded the Lamme Medal for achievement in engineering education. The presentation was made at the annual dinner of the Society for the Promotion of Engineering Education held at the University of Wisconsin.

ROLLAND W. CHASE recently resigned as superintendent of the CCC camp at Fair Haven, N.Y., to enter the employ of the Pennsylvania Water and Power Company at Holtwood, Pa.

DEAN F. PETERSON, JR., formerly junior engineer for the WPA in Utah, is now connected with the U. S. Indian Agency at Fort Washakie, Wyo.

CHARLES L. HALL, lieutenant colonel, Corps of Engineers, U. S. Army, who for the past four years has been in charge of the Cincinnati office of the U. S. Engineers, will be transferred to Fort Dupont, Del., on September 1. He will take command of the 1st regiment, Corps of Engineers.

BREHON B. SOMERVELL, lieutenant colonel, Corps of Engineers, U. S. Army, has been appointed WPA administrator for New York City. Colonel Somervell, who has been in charge of the Florida ship canal, will take over his new duties on August 1.

D. B. CASSELL, formerly with the West Slope Construction Company on San Gabriel Dam No. 1, near Los Angeles, Calif., is now resident engineer for the Bates and Rogers Construction Company on the construction of the San Francisco-Oakland Bay Bridge, at San Francisco.

ROBERT B. THOMPSON, former assistant sanitary engineer, Harvard Graduate School of Engineering, has become junior sanitary engineer for the Dorr Company at Westport, Conn.

DECEASED

CHARLES GEORGE ADSIT (M. '24) president of the Des Moines Railway, Des Moines, Iowa, died on March 27, 1935, at the age of 60. He was born in Ironton, Ohio. Mr. Adsit was in charge of the design and construction of several hydroelectric developments and power-transmission systems in the West. He constructed railroads in mining districts in this country and Mexico, and for a number of years was vice-president and executive engineer in charge of all engineering matters for the Georgia Railway and Power Company.

ARTHUR TAYLOR BRAGONIER (Assoc. M. '32) associate professor of applied mathematics at Marshall College, died at Huntington, W.Va., on June 29, 1936, at the age of 46. Mr. Bragonier was born in Shepherdstown, W.Va., and received degrees from Shepherd College, the University of Michigan, and West Virginia University. His career included experience as highway engineer for Virginia and West Virginia, county road engineer for Jackson County, and engineering instructor at West Virginia University. In 1925 he joined the staff of Marshall College, where he developed the pre-engineering department to an important place in the educational field.

JOHN BRUNNER (M. '98) a well-known engineer and metallurgist, died in Evanston, Ill., on June 15, 1936, at the age of 69. A native of Sweden, Mr. Brunner graduated from the Royal Institute of Technology in Stockholm in 1887. Soon afterward he came to this country, where he was employed by the Carnegie Steel Company as assistant chief engineer and by the City of Pittsburgh as bridge engineer. From 1902 on he was with the Illinois Steel Company, where he held various positions. Mr. Brunner won several awards for his research into the production of steel rails, and in 1919 he received a decoration from the King of Sweden.

BURTON PERCIVAL FLEMING (M. '17) chief engineer of the U. S. Soil Conservation Service for Utah, Colorado, Arizona, and New Mexico, died at Glendale, Calif., on May 26, 1936. He was 55. Mr. Fleming graduated from the Utah Agricultural College in 1900 and from Cornell University in 1906. He was employed by the Wyoming Experiment Station, the U. S. Department of Agriculture, and the U. S. Reclamation Service, and for a number of years was head of the department of mechanical engineering at the University of Iowa. He was the author of several articles on irrigation and pumping.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

ROBERT RIVES HANCOCK (M. '08) of Howardsville, Va., died on May 5, 1936. He was born in Howardsville on May 9, 1873. From 1892 to 1906 he was engaged in railroad construction in Colombia and Ecuador. In 1908 he joined the staff of the Philippine Railway Company, with headquarters in Iloilo, P.I. He remained there until his retirement in 1932. After three years as secretary of this railway, he became vice-president and general manager and, for a few years, served as president of the Manila Railroad.

LAWRENCE BRACKETT HOYT (M. '25) resident engineer for the Hampton River jetties and shore dikes, State Highway Department, Hampton, N.H., died there on June 1, 1936. He was 44. Mr. Hoyt was born at Greenland, N.H., and graduated from the Massachusetts Institute of Technology in 1913. From 1914 to 1925 he was with the Massachusetts Highway Division, serving as resident engineer on several large projects during this period. In 1925 he joined the staff of the New Hampshire Highway Commission.

AUGUST GUSTAVE KLEINBECK (M. '97) died at Litchfield, Ill., on February 8, 1936. He was born in Wurtenberg, Germany, on February 17, 1852, and graduated from the Royal Technic School of Stuttgart in 1869. In 1880 he came to this country where he was employed by various railroads, including the Tuskoluca, Montgomery, and Bainbridge Railroad (in Georgia), the Frisco Railroad Company, and the St. Louis, Brownsville, and Mexico Railroad Company. For the latter company he designed and built a bridge across the Brazos River in Texas. In 1907 illness forced his retirement from active practice.

ROBERT WENTWORTH MACINTYRE (M. '30) died in Victoria, B.C., on May 30, 1936, at the age of 68. He was born in London, England, and started his engineering career in Canada in 1890. Mr. Macintyre's experience included work on many land and railroad surveys. From 1915 to 1922 he was assistant to the chief engineer on the construction of the Pacific Great Eastern Railway. He was engineer of railways for the province of British Columbia from 1922 to 1924. Later Mr. Macintyre alternated railroad and municipal work with private practice. He retired in 1930.

FREDERIC O. X. MCLOUGHLIN (M. '32) professor of civil engineering at the College of the City of New York, died at his summer home in Big Indian, N.Y., on June 28, 1936. He was 48. He was born in New York City where he graduated from the College of the City of New York and Columbia University. In 1910 Professor McLoughlin joined the staff of the former institution, where he was promoted through all the teaching grades, to become a full professor. An expert on highway, bridge, and tunnel construction, Professor McLoughlin often served in a consulting capacity. He was also the author of several books on engineering.

ANDREW BENJAMIN MAUZY (M. '30) chief engineer of the Bureau of Water, Jersey City Bureau of Public Works, died in Jersey City, N.J., on June 19, 1936. He was born in Paterson, N.J., on March 5, 1891. From 1908 to 1918 he was assistant superintendent in the Paterson, N.J., water department. During the World War he saw foreign service. In 1921, after two years in the Bayonne, N.J., water department, he became water conservator and chief engineer in the Jersey City Bureau of Water.

JAMES COWAN MEEM (M. '05) consulting engineer for the Underpinning and Foundation Company of New York City, died in Brooklyn, N.Y., on June 24, 1936, at the age of 71. Mr. Meem was born in Knoxville, Tenn., and received B.S. and C.E. degrees from Virginia Military Institute. From 1902 on, Mr. Meem was engaged in tunnel and subway construction work in New York and Brooklyn, having been chief engineer of the Frederick L. Cranford Company, contractors, from 1908 to 1930. During this period he solved many underpinning problems in connection with the construction of the B.M.T., the I.R.T., and the Eighth Avenue subways. He was the author of many books and papers on engineering subjects.

GEORGE NELSON RANDLE (M. '09) city engineer of Oakland, Calif., died at Monrovia, Calif., on June 24, 1936, at the age of 63. He was born in Colusa, Calif., and began his engineering career in local surveying, and on water supply and sewage disposal works. He was city engineer of Sacramento, Calif., for a number of years. During this period he designed and erected a sewage pumping plant and public wharf, and extended the water and sewer systems.

Francis Stuart Williamson (M. '87) consulting engineer of Montreal, Canada, died on May 21, 1936. He was born at Derby, England, on October 23, 1860. Mr. Williamson was employed as assistant engineer on the construction of the Manhattan Valley Viaduct and Riverside Drive extension in New York City, and later in a similar capacity on the design of structures for the first New York and Boston subways. Beginning in 1895, he was for a number of years in private practice. From 1912 to 1914 Mr. Williamson was chief engineer of the Central Railway of Canada. Later he served in a consulting engineering capacity on a large number of important structural projects in this country and Canada.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From June 10 to July 9, 1936, Inclusive

Additions to Membership

Ashley, Joseph Densmore Edward (Assoc. M. '36), County Surv. and Supt. of Highways, Ford County; City Engr. of Gibson City; City Engr. (Res., 205 Center St.), Paxton, Ill.

Auerbach, Alvin Berthold (Jun. '36), Junior Engr., U. S. Engr. Office, Rock Island, Ill.

Barton, Robert Randolph (Assoc. M. '36), Res. Engr., C. P. Fortney, and Bridge Engr., E. R. Mills (Res., 112 Park Drive), Charleston, W.Va.

Brockway, George Samuel (Assoc. M. '36), Engr. (Fugate & Brockway); Consultant, Port of Palm Beach Administrative Authority; City Engr. (Res., 425 Sunset Rd.), West Palm Beach, Fla.

Buren, Clarence Willard (Jun. '36), 3364 North Central Ave., Chicago, Ill.

Cameron, Donald Wilber (Jun. '36), Under Eng. Aide, RA, 305 Montgomery St., Montgomery, Ala. (Res., Sylvan Shores, Mount Dora, Fla.)

Cannell, Paul John (Assoc. M. '36), Designer, Central Nebraska Power and Irrig. Dist., 508 Forest Boulevard, Hastings, Nebr.

Cherry, James Linton (Assoc. M. '36), Instr., Architectural Eng., Dept. of Architecture, Pennsylvania State Coll. (Res., 447 East Hamilton Ave.), State College, Pa.

Church, Joshua Price (M. '36), Dist. Highway Engr., State Highway Dept., Deming, N.Mex.

Cohn, Maurice Leonard (Jun. '36), 255 West 84th St., New York, N.Y.

Costinett, John Harrison (Jun. '36), Under Eng. Aide, U. S. Govt., Aberdeen Proving Grounds (Res., 125 Post Rd.), Aberdeen, Md.

Cowan, Merton Robert (Jun. '36), 918 Second St., S.W., Rochester, Minn.

Dahl, Harry Walter (Jun. '36), Rodman and Draftsman, State Road Comm. (Res., 1014 East 4th South St.), Salt Lake City, Utah.

Dearstyne, Samuel Charles (Assoc. M. '36), Structural Designer, Harbor Dept., City of Long Beach, Long Beach, (Res., 4819 Exposition Boulevard, Los Angeles), Calif.

Devlin, Harry Kerchever (Assoc. M. '36), Estimator, Gibbs & Hill, New York (Res., 440 East 22d St., Brooklyn), N.Y.

Dills, Charles Clinton (Assoc. M. '36), Industrial Hygiene Engr., State Board of Health (Res., 2028 New Hampshire St.), Lawrence, Kans.

Everts, Curtiss Mitchell, Jr. (Assoc. M. '36), Asst. State Director of Sanitation, U. S. Public Health Service, 816 Oregon Bldg., Portland, Ore.

Flanders, Royal Call, Jr. (Jun. '35), Surveyman, U. S. Engr. Dept., U. S. Engr. Office, Waterbury, Vt.

Francisco, Stephen Cooke (Jun. '36), Asst. to Roger Coupe, Paterson (Res., 22 St. Lukes Pl., Montclair), N.J.

Gegauff, Gustav (Jun. '35), Box 27, Absecon, N.J.

Gerardi, Jasper (Jun. '36), Instr., Surveying and Eng. Drawing, Univ. of Detroit (Res., 3660 Arndt), Detroit, Mich.

Hammond, George Warren (Jun. '36), Transitman, Suburban Homesteads, Hightstown Project, Hightstown (Res., Freehold), N.J.

Hanson, Thomas Cooper (Jun. '36), 1303 South Washington St., Kokomo, Ind.

Hartline, Waldo (M. '36), Civ., Min., and Structural Engr. (Arnold, Rosch & Hartline), New Philadelphia (Res., 1601 North Walnut St., Dover), Ohio.

Hayden, Robert (Assoc. M. '36), Senior Engr., Navy Yard (Res., 2540 Valentine Ave.), New York, N.Y.

Hazera, Elie (Jun. '35), Care, E. J. Hazera, Box 90, San José, Costa Rica.

Hendricks, James Tilman (Jun. '35), Box 91, Norris, Tenn.

Johnson, Bernard David (Assoc. M. '36), Acting Dist. Engr., State Road Comm. (Res., 305 South Mineral St.), Keyser, W.Va.

Lee, Robert Ernest (Jun. '36), Rodman, State Highway Dept., Box 149, Alvin, Tex.

McCosh, Stanley Armstrong (Assoc. M. '36), Asst. Prof., Civ. Eng., Colorado School of Mines, Golden (Res., 3540 Newton St., Denver), Colo.

Madsen, Ingvald Elias (Jun. '36), 8 Gilson Ave., Medford, Mass.

Mahone, John Thomas (Jun. '36), Planning Engr., SCS, ECW, 301 Larissa, Jacksonville, Tex.

Marx, Charles Henry (Assoc. M. '36), Designer, Water Purification Dept., City of Milwaukee (Res., 2436 West Kilbourn Ave.), Milwaukee, Wis.

TOTAL MEMBERSHIP AS OF JULY 9, 1936	
Members	5,712
Associate Members	6,242
Corporate Members	11,954
Honorary Members	19
Juniors	3,243
Affiliates	94
Fellow	1
Total	15,511

Miller, Arthur Leslie (Jun. '36), Draftsman, Metro Goldwyn Mayer Studios, 2935½ South Van Buren Pl., Los Angeles, Calif.

Molstad, Reginald (M. '36), Superv. Engr., Triborough Bridge, Inspection Div., PWA, 103 East 125th St. (Res., 156 Pinehurst Ave.), New York, N.Y.

Park, Kenneth Foote (Assoc. M. '36), Engr., R. G. LeTourneau, Inc., Peoria, Ill.

Peachey, Robert Anthon (Jun. '36), Supt. and Engr., Allison Land Co., Allison Park, Box 333, Coytesville, N.J.

Quenneville, Raymond Joseph (Jun. '36), 80 Bridge St., Holyoke, Mass.

Ramage, Harry Lawrence (M. '36), Chf. Engr. and Director, Tilghman Moyer Co. (Res., 2348 Tilghman St.), Allentown, Pa.

Restall, Robert Sidney (Jun. '36), 97 Sylvan St., Springfield, Mass.

Rich, Lowell Redd (Jun. '36), Project Engr., SCS, 422 North Amherst St., Albuquerque, N.Mex.

Roberts, Charles Pressley (M. '36), Civ. Eng. (Johnson & Roberts), Marion, S.C.

Seligmann, Gustav Leonard (Assoc. M. '36), Associate Engr., RA, Amarillo Bldg., Amarillo, Tex.

Starr, William Lawrence (Jun. '36), Chf. Draftsman, State Highway Dept., Lufkin, Tex.

Stevenson, Robert Gray (Assoc. M. '36), Associate Engr., U. S. Geological Survey, Box 346, Sacramento, Calif.

Stout, David Lester (Jun. '36), Computer, U. S. Coast and Geodetic Local Control Survey, Willow Rd., Lawrenceville, N.J.

Upton, William Bayly, Jr. (Assoc. M. '36), Associate Topographical Eng., U. S. Geological Survey, Box 346, Sacramento, Calif.

Vawter, Wallace Read (Assoc. M. '36), Civ. Engr., U. S. Engr. Office, Camp Roosevelt, Ocala, Fla.

Vose, Robert Weston (Jun. '36), Instr., Mech. Eng., Mass. Inst. Tech., Cambridge, Mass.

Walsh, John Burke (Assoc. M. '36), Structural Draftsman, Grade 4, Dept. of Docks, City of New York, New York (Res., 43-09 Forty-Seventh Ave., Long Island City), N.Y.

Weidner, Charles Kenneth (Jun. '36), Asst. Supt. of Buildings and Grounds, Univ. of Washington (Res., 4746 Twenty-First Ave., N.E.), Seattle, Wash.

White, Merit Penniman (Jun. '36), Junior Conservationist, SCS, 336 Sacramento St., Altadena, Calif.

WOOD, JOHN DUDLEY (Jun. '35), 130 Peyton St., Winchester, Va.

YORK, JAMES MOORING (Assoc. M. '36), Div. Office Engr., State Highway Dept., Div. 11 (Res., 416 Bremond Ave.), Lufkin, Tex.

ZOLLWEG, HERBERT AUGUSTUS (Assoc. M. '36), Computer, Eng. Dept., City of Rochester (Res., 171 Randolph St.), Rochester, N.Y.

MEMBERSHIP TRANSFERS

BARNES, HUGH DONALD (Assoc. M. '26; M. '36), State Highway Engr., State Highway Comm., Masonic Temple (Res., 3521 York Way), Topeka, Kans.

BOWERS, SAMUEL WARREN (Jun. '31; Assoc. M. '36), Engr. and Surv. (MacKenzie & Bowers) (Res., 104 Center St.), Southington, Conn.

BRYANS, CLYDE VENROY (Jun. '30; Assoc. M. '36), Road Engr., U. S. Indian Service, 405 Luhrs Tower, Phoenix, Ariz.

CADY, RALPH HOWE (Assoc. M. '23; M. '36), Engr. and Foreign Representative, Frederick Snare Corporation, 114 Liberty St., New York, N.Y.

CHOW, LEE, (Jun. '28; Assoc. M. '36), Senior Engr., Hydr. Dept., Shantung Reconstruction Bureau, Tsinan, Shantung, China.

DORE, STANLEY MILBURN (Assoc. M. '30; M. '36), Associate Civ. Engr., Met. Dist. Water Supply Comm. of Massachusetts, 20 Somerset St., Boston (Res., 120 Monroe St., Dedham), Mass.

DURR, CHARLES EUGENE, JR. (Jun. '31; Assoc. M. '36), Senior Engr., Unification of Building Codes, New York State Dept. of Labor, 80 Center St. (Res., 1989 Morris Ave.), New York, N.Y.

JOHNSON, ARTHUR (Jun. '25; Assoc. M. '36), Associate Engr., Power Section, Conservation Branch, U. S. Geological Survey, 406 Federal Bldg., Tacoma, Wash.

MITTAG, ALBERT ALFRED (Jun. '26; Assoc. M. '29; M. '36), Constr. Engr., Pan-American Airways, 135 East 42d St., New York, N.Y. (Res., 211 Bloomfield St., Hoboken, N.J.)

PARKER, JACOB SILAS, JR. (Jun. '30; Assoc. M. '36), Res. Engr., Fuller & McClintock, 11 Park Pl., New York, N.Y. (Res., 14 North Ave., Elizabeth, N.J.)

PECK, JOHN SANFORD (Jun. '16; Assoc. M. '21; M.' 36), Asst. Prof., in Chg. Materials Testing Laboratory, School of Technology, College of the City of New York, New York (Res., 169 Boulevard, Scarsdale), N.Y.

RODRIGUEZ Y CATARROJA, FILEMON (Jun. '31; Assoc. M. '36), Technical Asst., Dept. of Public Works and Communications, Manila, Philippine Islands.

SAGER, GEORGE HENRY, JR. (Assoc. M. '27; M. '36), Acting State Director, PWA for Kentucky, 705 Republic Bldg., Louisville, Ky.

SANTOS, ADOLPHO, JR. (Jun. '26; Assoc. M. '36), Asst. Hydr. Engr., The São Paulo Tramway Light & Power Co., Ltd., Caixa Postal "a" (minusculo), São Paulo, Brazil.

SCHOOLCRAFT, GEORGE BINGLY (Jun. '33; Assoc. M. '36), Project Engr., State Highway Comm., Box 373, Jeffersonville, Ind.

SHOCKLEY, DELL GEORGE (Jun. '29; Assoc. M. '36), Project Mgr., Indian ECW, Hualapai Indian Reservation, Peach Springs, Ariz.

TUNKARD, CLARENCE RUSSELL (Jun. '30; Assoc. M. '36), 3251 Forty-Fourth Ave., S.W., Seattle, Wash.

WALKER, ELDRED HERBERT (Assoc. M. '26; M. '36), Structural Engr., City Engrs. Office (Res., 25 Leander Rd.), Rochester, N.Y.

WRIGHT, THOMAS JUDSON, JR. (Jun. '09; Assoc. M. '12; M. '36), Mgr., Richmond Cedar Works and Dismal Swamp R.R.; R.F.D. 3, Norfolk, Va.

REINSTATEMENTS

COUSE, WALTER LEARNED, Assoc. M., reinstated June 19, 1936.

FRENCH, FRANK STURGILL, Assoc. M., reinstated June 26, 1936.

HAWKINS, WYATT SWIFT, M., reinstated June 22, 1936.

LÓPEZ BARALT, JOAQUIN, Jun., reinstated June 16, 1936.

NIELSEN, JENS EGEDE, Assoc. M., reinstated June 11, 1936.

REAGAN, CODY SYLVESTER, Assoc. M., reinstated June 15, 1936.

RESIGNATIONS

HANDMAN, FREDERICK WILLIAM ADOLPH, M., resigned June 23, 1936.

HOBBS, HENRY WEBSTER, M., resigned June 22, 1936.

MARSH, EDWARD THEODORE, Jun., resigned July 15, 1936.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment of Members to Board of Direction

August 1, 1936 NUMBER 8

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information. Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years*	5 years of important work
Associate Member	Qualified to direct work	27 years	8 years*	1 year
Junior	Qualified for sub-professional work	20 years †	4 years*	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years*	5 years of important work
Fellow	Contributor to the permanent funds of the Society			

* Graduation from an engineering school of recognized reputation is equivalent to 4 years of active practice.
† Membership ceases at age of 33 unless transferred to higher grade.

The fact that applicants refer to certain members does not necessarily mean that such members endorse.

ADMISSIONS

ABBOTT, WELLS OSBORN, Los Angeles, Calif. (Age 40.) Jun. Bridge Constr. Engr., California Div. of Highways. Refers to J. E. Jones, D. A. Lane, J. E. Phillips, E. A. Porter, H. A. Van Norman, D. R. Warren, P. R. Watson.

AGRANOVICH, LEO GREGORY, New York City. (Age 23.) Refers to H. P. Hammond, E. J. Squire.

AKSOY, IBRAHIM SABIT, Cinarlar, Giresun, Turkey. (Age 24.) Refers to J. S. Crandell, J. J. Doland, W. C. Huntington, G. W. Pickels, F. W. Stubbs, Jr.

ALBRECHT, RICHARD WILLIAM, Brooklyn, N.Y. (Age. 21.) Refers to H. P. Hammond, E. J. Squire.

AMMAZZALORSO, JOSEPH TOBIA, Ossining, N.Y. (Age 25.) Refers to L. V. Carpenter, C. T. Schwarze.

ANDERSON, THOMAS WILLIAM, Tacoma, Wash. (Age 24.) Refers to C. C. May, C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

ARATA, WINFIELD HECTOR, San Francisco, Calif. (Age 39.) Associate Concrete Inspector (Concrete Technologist), Golden Gate Bridge & Highway Dist. Refers to S. A. Chapman, A. P. Denton, H. M. Hadley, G. W. Hayler, J. A. Kitts.

Argus, Wilbert Lang, New Orleans, La. (Age 20.) Refers to D. Derickson, W. B. Gregory.

Arne, I. Christian, Chicago, Ill. (Age 28.) Jun. Highway Engr., State Div. of Highways. Refers to H. E. Babbitt, H. Cross, W. C. Huntington, W. H. Rayner, T. C. Shedd.

Arnold, Richard Roberts, Ft. Belvoir, Va. (Age 25.) 1st Lieut., Corps of Engrs., U. S. Army. Refers to C. Derleth, Jr., B. A. Etcheverry, B. Jameyson, M. P. O'Brien, C. T. Wiskocil.

Austin, Garry Heckman, Denver, Colo. (Age 23.) Refers to R. L. Downing, F. R. Dungan, C. L. Eckel, E. W. Raeder.

Austin, Robert Dale, Sacramento, Calif. (Age 22.) Jun. Laboratory Aid, California State Highway Research Laboratory. Refers to R. E. Davis, F. S. Foote, C. G. Hyde, B. Jameyson, C. T. Wiskocil.

Baillie, David Gemmell, Jr., Brooklyn, N.Y. (Age 42.) Asst. Engr., New York City Tunnel Authority, Chf. Engr.'s Office, New York City. Refers to M. E. Gilmore, W. M. Griffin, H. P. R. Jacobsen, J. Mechanic, J. J. Nanry, R. Ridgway, L. E. Robbe, O. Singstad, J. B. Snow, A. S. Tuttle.

Bartley, John Coleman, New Orleans, La. (Age 20.) Refers to D. Derickson, W. B. Gregory.

Bergeson, John True, Newton Centre, Mass. (Age 21.) Refers to W. R. Benford, L. T. Bohl.

Berkem, Muhittin Kasif, Burdur, Turkey. (Age 22.) Superv. Engr. with S. Durusan, Engr. Refers to J. S. Crandell, H. Cross, W. C. Huntington, E. E. King, E. S. Sheiry.

Bisso, Louis Clarence, New Orleans, La. (Age 20.) Refers to D. Derickson, W. B. Gregory.

Bjork, Wilbert Milton, Seattle, Wash. (Age 23.) Refers to C. C. More, F. H. Rhodes, Jr.

Blake, Warner Paul, Aberdeen, S.Dak. (Age 22.) Refers to F. Bass, A. S. Cutler, L. G. Straub.

Blossman, Edward Woodrow, Covington, La. (Age 22.) Refers to D. Derickson, W. B. Gregory.

Boccio, Joseph Michael, Flushing. N.Y. (Age 28.) Refers to L. V. Carpenter, C. T. Schwarze, D. S. Trowbridge.

Boucher, Francis Le Roy, Millington, N.J. (Age 23.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Bow, Wilson Francis, Moscow, Idaho. (Age 23.) Refers to I. N. Carter, I. C. Crawford.

Bowen, Frank Milton, Ann Arbor, Mich. (Age 48.) Principal, Jensen, Bowen & Farrell, Engrs. Refers to E. B. Black, M. E. Cooley, W. C. Hoad, O. A. R. V. Jensen, H. E. Riggs, J. E. Sirrine, N. T. Veatch, Jr.

Boylan, John Dudley, Knoxville, Tenn. (Age 22.) Apprentice Engr. Draftsman, Dams Div., TVA. Refers to F. H. Eno, C. T. Morris, J. C. Prior, J. R. Shank, R. C. Sloane.

Brandow, George Everett, Los Angeles, Calif. (Age 22.) Jun. Structural Engr. with W. E. Wilson. Refers to R. M. Fox, A. Jones, D. A. Lane, D. M. Wilson, W. E. Wilson.

Brendel, Robert Oliver, East St. Louis, Ill. (Age 25.) Refers to J. J. Doland, M. L. Enger.

Briganti, Theodore, New York City. (Age 22.) Refers to C. T. Schwarze, D. S. Trowbridge.

Brindley, John Herbert, Fall River, Mass. (Age 20.) Refers to W. R. Benford, L. T. Bohl.

Brooks, George Everett, Worcester, Mass. (Age 23.) Refers to A. W. French, J. W. Howe, A. J. Knight, C. F. Meyer.

Bryan, Bruce, Lubbock, Tex. (Age 29.) Refers to O. V. Adams, J. H. Murdough, G. W. Parkhill.

Burge, Eugene Field, Los Angeles, Calif. (Age 26.) Asst. Res. Engr., California State Highway Comm. Refers to S. V. Cortelyou, A. N. George, A. D. Griffin, R. W. Hutchinson, P. R. Watson.

Burns, Daniel William, Boston, Mass. (Age 24.) Refers to J. B. Babcock, 3d, J. D. Mitsch.

Burr, Percy Nelson, Union, N.J. (Age 43.) Chf. Designing Engr., Runyon & Carey, Cons. Engrs., Newark, N.J. Refers to W. G. Bank, J. L. Bauer, W. H. Boardman, S. C. Hamilton, Jr., G. T. Hand, H. W. Heilmann, E. D. Powers.

Burrows, Edward Joseph, East Cleveland, Ohio. (Age 23.) Refers to J. M. Montz, C. T. Morris, J. C. Prior, J. R. Shank, R. C. Sloane.

Byrnes, Harry Cady, New Hampton, N.Y. (Age 53.) Supt. of Constr., Corps of Engrs. U. S. Army. Refers to A. S. Crane, L. H. Huntley, S. R. Jones, G. R. Lukesh, E. G. Williams.

Campbell, Edwin Mouzon, Pittsburg, Tex. (Age 26.) Refers to O. B. Adams, J. H. Murdough, G. W. Parkhill.

Carter, Marshall Sylvester, West Point, N.Y. (Age 26.) Refers to H. K. Barrows, C. B. Breed, W. M. Fife, K. C. Reynolds, G. E. Russell.

Cass, Walter Elmer, Pittsburgh, Pa. (Age 29.) Refers to A. Diefendorf, L. C. McCandliss.

Chase, Isaac, Newport, R.I. (Age 22.) Refers to C. D. Billmyer, J. L. Murray.

Christman, William Rawle, Akron, Ohio. (Age 23.) Refers to F. E. Ayer, J. W. Bulger, R. C. Durst, G. B. Sowers.

Clanton, Jack Reed, Forest City, Mo. (Age 22.) Refers to C. E. S. Bardsley, H. C. Beckman, J. B. Butler, E. W. Carlton, E. G. Harris, 2d Lieut., Engr. Reserves, U. S. Army.

Clulo, James Aloisius, Norway, Mich. (Age 35.) City Engr. Refers to L. M. Gram, C. Paul, W. C. Sadler, R. H. Sherlock, J. S. Worley, R. C. Young.

Cohan, Adolph, Los Angeles, Calif. (Age 21.) Refers to R. M. Fox, D. M. Wilson.

Coonan, Lawrence Bernard, Brooklyn, N.Y. (Age 28.) Eng. Asst., Dept. of Water Supply, Gas & Electricity. Refers to F. E. Foss, G. Morrison.

Coopey, Martin Portman, Corvallis, Ore. (Age 25.) Refers to J. R. Griffith, G. W. Holcomb, F. Merryfield, C. A. Mockmore.

Cornell, Russel Marble, Minneapolis, Minn. (Age 25.) Refers to F. Bass, A. S. Cutler, J. I. Parcel.

Crowle, Herbert George, Berkeley, Calif. (Age 20.) Refers to C. Derleth, Jr., F. S. Foote, B. Jameyson, C. T. Wiskocil.

Cutts, Charles Eugene, St. Paul, Minn. (Age 22.) Refers to F. Bass, A. S. Cutler, O. M. Leland, L. G. Straub.

Daily, Eugene Joseph, Rolla, Mo. (Age 22.) Refers to C. E. S. Bardsley, H. C. Beckman, J. B. Butler, E. W. Carlton, C. V. Mann.

Dallas, John, Jr., North Wales, Pa. (Age 24.) Instructor, Dept. of Architecture, Pennsylvania State Coll., State College, Pa. Refers to C. L. Harris, R. L. Sackett.

Dando, George Albert, Columbus, Ohio. (Age 21.) Refers to C. T. Morris, R. C. Sloane.

Dansker, Edward, New York City. (Age 21.) Refers to L. V. Carpenter, C. T. Schwarze.

Davenport, Theodore, Netcong, N.J. (Age 22.) Refers to H. G. Payrow, C. H. Sutherland.

David, Byron Benjamin, Albuquerque, N.Mex. (Age 24.) Refers to J. H. Dorroh, R. H. A. Rupkey.

Davis, John Williams, Mill Valley, Calif. (Age 26.) Refers to E. E. Blackie, B. A. Etcheverry, C. G. Hyde, C. T. Wiskocil, H. I. Wood.

Davison, James Golden, Niagara Falls, N.Y. (Age 43.) Contr. Engr. on design and construction of buildings, sewers, breakwaters and docks. Refers to G. W. Carlton, E. P. Lupfer, J. T. Mocker, S. S. Neff, E. G. Speyer.

Dillon, Emmett Parnell, Albuquerque, N.Mex. (Age 23.) Refers to J. H. Dorroh, R. H. A. Rupkey.

Dobbins, William Earl, Woburn, Mass. (Age 23.) Research Asst., Dept. of Civ. and San. Eng., Massachusetts Inst. of Technology, Cambridge, Mass. Refers to J. B. Babcock, 3d, C. B. Breed, T. R. Camp, W. M. Fife, G. E. Russell, W. C. Voss.

Dobrochowski, Vincent Joseph, Rochester, N.Y. (Age 22.) Refers to J. B. Babcock, 3d, C. B. Breed.

Draper, Philip Clinton, Bloomfield, N.J. (Age 22.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Dugan, Albert Francis, New Orleans, La. (Age 23.) Refers to D. Derickson, W. B. Gregory.

Dukes, William Weaver, Georgetown, Ill. (Age 22.) Refers to G. W. Pickels, F. W. Stubbs, Jr.

Ellis, Harry Kaler, Phoenixville, Pa. (Age 49.) Draftsman and Checker, Bethlehem Steel Co., Pottstown, Pa. Refers to W. F. Carson, W. C. Emigh, E. Harrop, C. D. Jensen, J. R. Lambert, J. P. H. Liebsch, C. W. MacCornack, H. H. Quimby, S. H. Widdicombe.

Epple, Robert Edward, Rutherford, N.J. (Age 22.) Refers to H. E. Breed, L. V. Carpenter, A. Haring, T. Saville, C. T. Schwarze.

Ettinger, Richard Eugene, Skaneateles, N.Y. (Age. 22.) Refers to E. F. Berry, L. Mitchell, S. D. Sarason.

Evans, Richard Allen, Casper, Wyo. (Age 24.) Refers to R. D. Goodrich, E. K. Nelson, H. T. Person.

Fieldstad, Norman Sigur, Opportunity, Wash. (Age 26.) Refers to R. G. Hennes, F. H. Rhodes, Jr., R. G. Tyler.

Fifield, Myron Fickas, Albuquerque, N.Mex. (Age 21.) Refers to J. H. Dorroh, H. C. Neuffer, R. H. A. Rupkey, A. N. Thompson.

Fleet, Gerald Allen, New York City. (Age 20.) Refers to L. V. Carpenter, A. Haring, T. Saville, C. T. Schwarze.

Fletcher, Robert Joseph, Flushing, N.Y. (Age 22.) Refers to R. C. Brumfield, F. E. Foss.

Floyd, Dan Wilson, Lexington, Miss. (Age 23.) Eng. Aide, U. S. Dept. of Agriculture. Refers to G. H. Barton, C. E. Downing, A. B. Hargis.

Foehl, Paul Joseph, Denver, Colo. (Age 23.) Refers to W. E. Brockway, C. L. Eckel, E. W. Raeder.

Frank, Herbert Foster, Newark, N.J. (Age 22.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Frazier, Francis Virgil, Los Angeles, Calif. (Age 23.) Refers to F. J. Converse, R. R. Martel, W. W. Michael, F. Thomas, D. E. Whelan, Jr.

FREIGENBERG, SEYMOUR, New York City. (Age 21.) Refers to L. V. Carpenter, C. T. Schwarze.

FREUND, PAUL FRANKLIN, Ft. Jennings, Ohio. (Age 21.) Refers to L. H. Gardner, A. R. Webb.

GADKOWSKI, WALTER, Irvington, N.J. (Age 22.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

GAIDA, JOSEPH, New York City. (Age 25.) Refers to W. Allan, F. O. X. McLoughlin.

GENNELL, LEE ANTHONY, Maplewood, N.J. (Age 21.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

GESELE, FRANK EDWARD, Fort Peck, Mont. (Age 30.) Tunnel Inspector U. S. Engr. Dept. Refers to T. J. Carlile, J. J. Durfee J. A. Lenecek, F. H. Phipps, J. K. Smith.

GIANNOTTI, ALFRED, New York City. (Age 20.) Refers to L. V. Carpenter, C. T. Schwarze.

GIBSON, WILLIAM CHARLES, St. Albans, N.Y. (Age 21.) Refers to L. V. Carpenter, A. K. Johnson, T. Saville, C. T. Schwarze, D. S. Trowbridge, S. F. Yasines.

GIDDINGS, WILLIAM ARTHUR, Sacramento, Calif. (Age 21.) Refers to C. Derleth, Jr., B. A. Etcheverry.

GIESENHAIN, LLOYD HARLEY, Robbinsdale, Minn. (Age 22.) Refers to F. Bass, A. S. Cutler, L. G. Straub.

GILL, IRVING LEO, Washington, D.C. (Age 53.) Signal Engr., Chf. Signal Div., Bureau of Lighthouses, U. S. Govt. Refers to G. E. Edgerton, H. D. King, E. M. Markham, C. A. Park, G. B. Pillsbury, G. R. Putnam, R. R. Tinkham.

GLASBAND, HYMAN SAUL, Hartford, Conn. (Age 21.) Refers to H. E. Breed, C. T. Schwarze.

GOETTL, JOHN PHILIP, St. Paul, Minn. (Age 23.) Refers to F. Bass, A. S. Cutler, L. G. Straub.

GORDON, BERNARD BENJAMIN, Allston, Mass. (Age 21.) Refers to J. B. Babcock 3d, C. B. Breed, J. D. Mitsch.

GRAFF, ROBERT LOWELL, Tipton, Ind. (Age 25.) Refers to C. A. Ellis, R. B. Wiley.

GREELY, JAMES WESTWOOD, Seattle, Wash. (Age 21.) Refers to G. E. Hawthorn, H. W. McCurdy, C. C. More, F. H. Rhodes, Jr., W. D. Shannon, R. G. Tyler, R. B. Van Horn.

GREGORY, THEODORE ROY, San Marino, Calif. (Age 21.) Chainman, Metropolitan Water Dist. of Southern California. Refers to B. Jameyson, N. B. Smith, C. T. Wiskocil.

GRUBER, HOWARD LOUIS JOHN, St. Louis, Mo. (Age 22.) Refers to G. E. Galt, W. W. Horner, E. O. Sweetser.

GUTHRIE, JOHN SAMUEL, Ft. Worth, Tex. (Age 28.) Refers to O. V. Adams, J. H. Murdough, G. W. Parkhill.

HABER, RICHARD ADAM, Wilmington, Del. (Age 21.) Laboratory Asst., Delaware State Highway Dept. Refers to T. D. Mylrea, H. K. Preston.

HALE, KENNETH, New York City. (Age 21.) Refers to L. V. Carpenter, C. T. Schwarze.

HALL, WILLIAM GRAHAM, Pittsburgh, Pa. (Age 25.) Refers to A. Diefendorf, L. C. McCandliss.

HANCE, TOLLIFF RHINESBERG, Riverton, Wyo. (Age 25.) Asst. Supervisor of Water Research, WPA. Refers to R. D. Goodrich, H. T. Person, E. K. Nelson.

HARDING, ROBERT NELSON, Dallas, Tex. (Age 23.) Refers to J. H. Murdough, G. W. Parkhill.

HARLEY, PAUL LAZERN, Russell, Kans. (Age 23.) Refers to C. L. Eckel, E. W. Raeder.

HAUCK, ARTHUR ERNEST, Brooklyn, N.Y. (Age 23.) Refers to P. A. Rice, S. B. Williamson.

HAVER, ELMER CONNET, West Lafayette, Ind. (Age 21.) Refers to C. A. Ellis, W. K. Hatt, W. J. Henderson, R. B. Wiley.

HECKER, SOLOMON, Baltimore, Md. (Age 36.) Jun. Civ. Engr., Asst. Constr. Engr., Bureau of Sewers, City of Baltimore. Refers to E. L. Bandy, A. F. Di Domenico, G. E. Finck, A. H. Hartman, C. E. Keefer, R. T. Regester, M. E. Scheidt, F. C. Wachter.

HIERONYMUS, ROBERT CRAWFORD, Urbana, Ill. (Age 22.) Refers to H. Cross, W. C. Huntington.

HOLCOMB, ROBERT MARION, JR., Tucson, Ariz. (Age 20.) Refers to E. S. Borgquist, F. C. Kelton, J. C. Park.

HUFFERD, JOSEPH ALVIN, Lincoln, Nebr. (Age 26.) Jun. Engr., Nebraska Dept. of Roads & Irrigation. Refers to J. G. Mason, C. C. Nicholls, A. L. Ogle, H. G. Schlitt, C. E. Spellman.

JENNINGS, ROY TURNEY, Atlanta, Ga. (Age 27.) Refers to N. W. Dougherty, H. H. Hale.

JENNISON, JAMES HENRY, Pasadena, Calif. (Age 25.) Refers to A. Jones, R. R. Martel, W. W. Michael, F. Thomas.

JENSEN, EMIL CHRISTIAN, Burlington, Wash. (Age 23.) Refers to C. W. Harris, G. E. Hawthorn, C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

JOHNSON, WAYNE PFOST, Urich, Mo. (Age 21.) Refers to R. B. B. Moorman, H. K. Rubey.

JOHNSTON, JAMES WILBUR, New Hope, Ala. (Age 24.) With TVA, Guntersville Dam. Refers to J. G. Allen, N. W. Dougherty.

JONES, HOWARD RICHARD, Washington, D.C. (Age 36.) Senior Civ. Engr., U. S. Forest Service. Refers to M. B. Arthur, J. C. Dort, R. S. Henderson, E. W. Kramer, T. W. Norcross.

JONES, RUDARD ARTABAN, Indianapolis, Ind. (Age 23.) Refers to N. D. Morgan, C. E. Palmer.

KALLEE, NATHAN RICHARD, New York City. (Age 21.) Refers to L. V. Carpenter, C. T. Schwarze, S. F. Yasines.

KALMBACH, OLIN, Denver, Colo. (Age 23.) Asst. to R. J. Tipton, Cons. Engr. Refers to E. O. Bergman, R. L. Downing, C. L. Eckel, E. W. Raeder, W. H. Thoman, R. J. Tipton.

KAMALSKY, THOMAS KARL, Watertown, N.Y. (Age 24.) Refers to E. F. Berry, E. F. Church, G. D. Holmes, L. Mitchell, S. D. Sarason.

KANE, SAMUEL MARVIN, Brooklyn, N.Y. (Age 21.) Refers to L. V. Carpenter, A. Haring, C. T. Schwarze, D. S. Trowbridge.

KEENAN, RICHARD WILLIAM, Worcester, Mass. (Age 21.) Refers to A. W. French, J. W. Howe, C. F. Meyer.

KEMPE, FRANK ARTHUR, JR., St. Paul, Minn. (Age 21.) Jun. Draftsman, Minnesota Highway Dept. Refers to F. Bass, A. S. Cutler, A. A. McCree.

KENISTON, FRANK MERTON, Seattle, Wash. (Age 24.) Refers to C. W. Harris, R. G. Hennes, C. C. More, R. G. Tyler, R. B. Van Horn.

KETCHEN, ALECK PETRIE, Boise, Idaho. (Age 29.) Refers to J. E. Buchanan, I. N. Carter, I. C. Crawford, J. W. Howard.

KEYES, FRANCIS HOLMES, Pocatello, Idaho. (Age 25.) Refers to J. E. Buchanan, I. N. Carter, I. C. Crawford, J. W. Howard.

KIESEL, CHARLES BERNHARD, Jr., Manhasset, N.Y. (Age 22.) Refers to W. R. Benford, L. T. Bohl.

KIGER, WALLACE LEE, Pasadena, Calif. (Age 22.) Refers to R. R. Martel, F. Thomas.

KING, WILLIAM CECIL, Seattle, Wash. (Age 29.) Refers to I. L. Collier, G. E. Hawthorn, R. G. Hennes, C. C. More, F. H. Rhodes, Jr., R. G. Tyler.

KINGHORN, ANDERSON MILLS, Orangeburg, S.C. (Age 22.) Refers to E. L. Clarke, D. D. Curtis, F. R. I. Sweeny.

KINNEAR, EDWIN RAYMOND, Colorado Springs, Colo. (Age 37.) Chf. Engr., Soil Conservation Service, Dept. of Interior. Refers to S. T. Barker, A. G. Chapman, H. B. Gates, R. S. Goodridge, R. W. Hebard, C. M. Lightburn.

KOOMOS, GEORGE LOUIS, Oxford, Miss. (Age 28.) Refers to A. B. Hargis, R. B. B. Moorman.

KOOZIN, VICTOR TIMOTHY, Seattle, Wash. (Age 22.) Draftsman for Washington Instrument Co. and Standard X-Ray Sales Co. Refers to I. L. Collier, G. E. Hawthorn, C. C. More, R. G. Tyler, R. B. Van Horn.

LATIMER, ELLIS HANON, Jr., Okolona, Miss. (Age. 24.) Refers to A. B. Hargis, R. B. B. Moorman.

LAWRENCE, WILLIAM DAY, Ardsley, N.Y. (Age 20.) Refers to L. V. Carpenter, C. T. Schwarze.

LEADABRAND, JOSEPH ALBRIGHT, Chicago, Ill. (Age 23.) Refers to M. D. Catton, J. S. Crandell, T. C. Shedd, F. T. Sheets.

LEBSACK, REUBEN D., Hastings, Nebr. (Age 30.) Designer, Central Nebraska Public Power & Irrigation Dist. Refers to H. J. Kesner, J. G. Mason, C. E. Mickey, J. Sorkin, K. E. Vogel.

LE FEBER, CHARLES LEROY, Albuquerque, New Mex. (Age 21.) Refers to J. H. Dorroh, R. H. A. Rupkey.

LESSARD, FRANCIS HENRY, Brockton, Mass. (Age 22.) Refers to H. K. Barrows, J. D. Mitsch.

LEWIS, WALTER SMITH, New York City. (Age 23.) Refers to H. R. Bouton, C. T. Schwarze.

LIEBER, HENRY GEORGE, Woodhaven, N.Y. (Age 20.) Refers to R. C. Brumfield, F. E. Foss, G. Morrison.

LINDSTROM, WILLIAM AUGUST, New York City. (Age 23.) Refers to L. V. Carpenter, C. T. Schwarze.

LUCAS, FRANK EARL, Corvallis, Ore. (Age 25.) Refers to F. Merryfield, C. A. Mockmore.

LYON, HENRY LOUIS, San Francisco, Calif. (Age 57.) With Dept. of Agriculture, U. S. Bureau of Public Roads, Dist. 2. Refers to A. B. Brown, F. C. Herrmann, S. Murray, G. W. Rear, C. H. Sweetser, G. D. Whittle.

MABIE, HENRY CLAY, Jamaica Plain, Mass. (Age 25.) Refers to J. D. Mitsch, C. M. Spofford.

MACLEAN, CHARLES BUCK, Hartford, Conn. (Age 25.) Refers to W. S. Evans, E. H. Sprague.

MCCLUSKEY, WILLIAM OLIVER, III, Wheeling, W.Va. (Age 22.) Refers to A. Diefendorf, L. C. McCandliss, W. O. McCluskey, Jr.

MCCOY, JOHN DAVID, Albuquerque, N.Mex. (Age 28.) Refers to J. H. Dorroh, R. H. A. Rupkey.

MCDONALD, ROBERT LEE, Seattle, Wash. (Age 25.) Refers to C. W. Harris, C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

MCKENDRICK, MAURICE NILSSON, Salt Lake City, Utah. (Age 22.) Refers to T. C. Adams, R. B. Ketchum.

MCKINLEY, HENRY, Indianapolis, Ind. (Age 23.) Refers to N. D. Morgan, C. E. Palmer.

MALLOY, AMBROSE JOHN, New York City. (Age 23.) Refers to F. O. X. McLoughlin, J. C. Rathbun.

Mann, Carleton Foote, Gainesville, Fla. (Age 24.) Computer with G. D. Barnhart on State Mapping Project. Refers to T. M. Lowe, P. L. Reed.

Mann, Neil Warren, Dallas, Tex. (Age 23.) Refers to J. F. Brookes, N. E. Wolfard.

Marshall, David McLaren, Nutley, N.J. (Age 22.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Martin, George Blair, Pittsburgh, Pa. (Age 22.) Refers to A. Diefendorf, L. C. McCandliss.

Martinez, Federico, Jr., Tampico, Mexico. (Age 24.) Refers to P. M. Ferguson, J. A. Focht.

Martinez, Henry Augustus, Casper, Wyo. (Age 27.) Rodman, Bureau of Reclamation. Refers to R. D. Goodrich, H. T. Person.

Mathewson, Preston Daniel, Jr., Edgewood, R.I. (Age 21.) Refers to C. D. Billmyer, J. L. Murray.

Medbery, Hiram Christopher, Berkeley, Calif. (Age 26.) Draftsman, Alameda County Mosquito Abatement Dist. Refers to H. F. Gray, C. G. Hyde, A. Jones.

Meisell, Harry Ernest, Gainesville, Tex. (Age 21.) Rodman, Texas State Highway Dept. Refers to J. T. L. McNew, J. J. Richey.

Menefee, Raymond Harold, Rantoul, Ill. (Age 20.) Refers to W. C. Huntington, T. C. Shedd.

Meneghelli, Hugo Antonio, San Salvador, Salvador. (Temporary address, Hollywood, Calif.) (Age 24.) Refers to R. R. Martel, W. W. Michael, V. L. Peugh, F. Thomas.

Miller, Everett, Newark, N.J. (Age 21.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Miller, Fabian Sebastian, Palo Alto, Calif. (Age 42.) Asst. City Engr. Refers to J. F. Byxbee, W. B. McMillan, C. D. Marx, F. Mears, L. B. Reynolds, E. C. Thomas, J. B. Wells.

Miller, Ward B., Garrett, Ind. (Age 21.) Refers to C. A. Ellis, R. B. Wiley.

Miner, Clarence Crosiar, Chattanooga, Tenn. (Age 39.) Chf. Computer, TVA. Refers to C. A. Betts, N. W. Dougherty, O. J. Miller, T. P. Pendleton, G. D. Whitmore, C. P. Wright.

Morris, Irvin Daniel, Kettle Falls, Wash. (Age 26.) Refers to R. G. Hennes, I. D. S. Kelly, C. C. More, R. G. Tyler, R. B. Van Horn.

Muceus, Francis Kristian, Centerville, Iowa. (Age 34.) Camp Supt., ECW, U. S. Forest Service, Soil Conservation Service. Refers to Q. C. Ayres, R. A. Caughey, A. Daniels, A. H. Fuller, J. R. Maher, Sr., R. E. Robertson.

Mullen, John William Patrick, New Orleans, La. (Age 26.) Refers to D. Derickson, W. B. Gregory.

Murawski, Jerome Joseph, Paterson, N.J. (Age 21.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Nelson, Thomas Robert, Rapid City, S.Dak. (Age 22.) Refers to A. A. Chenoweth, E. D. Dake, R. E. Kennedy.

Newman Walter Charles, Jr., Johnston, R.I. (Age 20.) Refers to W. R. Benford, L. T. Bohl, H. E. Miller.

Newton, William Glen, Idalou, Tex. (Age 21.) Refers to O. V. Adams, J. H. Murdough, G. W. Parkhill.

Nolan, Charles Groetzinger, Portland, Pa. (Age 26.) Refers to W. S. Lohr, L. Perry, E. H. Rockwell.

Norby, Walter Arnold, Ashby, Minn. (Age 27.) With Ottertail County Highway Dept., Fergus Falls, Minn. Refers to H. M. Fitch, W. E. Smith.

Oak, Emmet Joseph, New York City. (Age 23.) Refers to W. Allan, J. C. Rathbun.

Olson, Carl Olaf, Everett, Mass. (Age 25.) Refers to J. D. Mitsch, C. M. Spofford.

O'Neill, Ralph Sheldon, Folson, S.Dak. (Age 28.) Refers to A. A. Chenoweth, E. D. Dake.

Orrison, William Wallace, Boston, Mass. (Age 24.) Graduate student, Mass. Inst. Tech., Cambridge, Mass. Refers to W. M. Fife, J. D. Mitsch, D. Peabody, Jr., C. M. Spofford, J. B. Wilbur.

Ottinger, Fred John, Jersey City, N.J. (Age 21.) Refers to L. V. Carpenter, A. Haring, C. T. Schwarze.

Page, Harry Francis, Jr., Baltimore Md. (Age 21.) Refers to T. F. Comber, Jr., J. H. Gregory, T. F. Hubbard, F. W. Medaugh, J. T. Thompson.

Paller, Jack, Los Angeles, Calif. (Age 21.) Refers to R. R. Martel, F. Thomas.

Patterson, Charles Bird, Gainesville, Fla. (Age 21.) Asst. Technician, Nat'l. Resources Comm. Drainage Basin Survey. Refers to W. W. Fineren, T. M. Lowe, P. L. Reed, W. L. Sawyer, D. S. Wallace.

Phelps, Alan Jerome, St. Paul, Minn. (Age 23.) Refers to F. Bass, A. S. Cutler, L. G. Straub.

Piazza, Sal Joseph, New York City. (Age 21.) Refers to T. Saville, C. T. Schwarze.

Piggott, John Edmund, Longmeadow, Mass. (Age 22.) Refers to W. R. Benford, L. T. Bohl, H. E. Miller.

Prime, Ellis Roy, Kingston, R.I. (Age 23.) Refers to C. D. Billmyer, J. L. Murray.

Raffo, Edward Francis, Rutherford, N.J. (Age 23.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Raleigh, John Clark, Chicago, Ill. (Age 23.) Refers to J. J. Doland, G. W. Pickels.

Randall, Frank Gilbert, Wadsworth, Ohio. (Age 23.) Refers to W. W. Anderson, A. R. Webb.

Redmond, Wilbert, Port Richmond, Staten Island, N.Y. (Age 24.) Refers to L. V. Carpenter, C. T. Schwarze.

Reinhardt, Edward Frank, Jersey City, N.J. (Age 28.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Richter, William Ernest, Indianapolis, Ind. (Age 21.) Refers to C. A. Ellis, M. R. Keefe, F. Kellam, R. B. Wiley.

Rihm, Alexander, Jr., South Ozone Park, N.Y. (Age 20.) Refers to L. V. Carpenter, C. T. Schwarze, D. S. Trowbridge.

Roberts, Albert Kimball, Kansas City, Mo. (Age 24.) Perry McGlone Constr. Co. Refers to A. L. Hyde, R. B. B. Moorman, H. K. Rubey.

Robins, Thomas Matthews, Portland, Ore. (Age 55.) Colonel, U. S. Army, being Div. Engr., North Pacific Div., Corps of Engrs. Refers to W. J. Barden, I. C. Crawford, F. C. Herrmann, J. P. Hogan, E. M. Markham, J. H. Polhemus, J. C. Stevens.

Rockett, Louis Newbern, Hattiesburg, Miss. (Age 23.) Refers to A. B. Hargis, R. B. B. Moorman.

Romig, William Davis, Boulder, Colo. (Age 21.) With Bureau of Reclamation, Denver, Colo. Refers to R. L. Downing, F. R. Dungan, C. L. Eckel, E. W. Raeder, W. H. Thoman.

Rotheram, John Jacques, Tarentum, Pa. (Age 24.) Refers to A. Diefendorf, L. C. McCandliss.

Rover, John, Brooklyn, N.Y. (Age 21.) Refers to H. P. Hammond, E. J. Squire.

Runstad, Harold John, Seattle, Wash. (Age 25.) Refers to C. W. Harris, C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

Salvato, Joseph Christopher Anthony, Jr., Middle Village, N.Y. (Age 21.) Refers to L. V. Carpenter, T. Saville, C. T. Schwarze.

Samuelson, Thomas Lister, Seattle, Wash. (Age 23.) Refers to I. L. Collier, C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

Schaaf, Robert Rudolph, Union, N.J. (Age 20.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Schoell, William Davenport, Detroit Lakes, Minn. (Age 21.) Refers to F. Bass, A. S. Cutler, O. M. Leland, L. G. Straub.

Shannon, William Lovejoy, Seattle, Wash. (Age 22.) Refers to J. C. Greely, G. E. Hawthorn, R. G. Hennes, C. C. More, R. G. Tyler, R. B. Van Horn.

Sherman, Dana Carroll, Mansfield, Mass. (Age 23.) Refers to C. D. Billmyer, J. L. Murray.

Silber, Victor Arthur, St. Louis, Mo. (Age 23.) Refers to C. E. Galt, W. W. Horner, E. O. Sweetser.

Slaton, Alan Lee, New York City. (Age 29.) With Transit Comm., New York City. Refers to L. H. Csanyi, H. Heins, J. F. Kern, L. F. Rader, E. J. Squire.

Smith, Charles Brown, Columbus, Ohio. (Age 21.) Refers to J. M. Montz, C. T. Morris, W. G. Smith.

Smith, Earl LeRoy, Twin Falls, Idaho. (Age 22.) Refers to J. E. Buchanan, I. N. Carter, I. C. Crawford, J. W. Howard.

Smith, Franklin Folk, Topton, Pa. (Age 22.) Refers to H. N. Benkert, H. K. Kistler, R. O'Donnell, E. D. Walker, L. W. Whitehead.

Smith, Jack Ferguson, Dallas, Tex. (Age 22.) Refers to P. M. Ferguson, J. A. Focht.

Squires, Franklin Wardwell, Philadelphia, Pa. (Age 21.) Eng. Apprentice, M. of W. Dept., Pennsylvania R.R. Refers to C. T. Bishop, G. F. Eckhard, C. S. Farnham, P. G. Laurson, R. H. Suttie.

Starke, William Wallace, Jr., Norfolk, Va. (Age 23.) Refers to S. Burnley, J. L. Newcomb.

Steiner, Richard Lewis, Baltimore, Md. (Age 22.) Refers to R. H. Suttie, J. C. Tracy.

Sterba, Antonin Messenger, Chicago, Ill. (Age 22.) Refers to J. J. Doland, T. C. Shedd.

Stevens, John Thomas, Orange, N.J. (Age 23.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Stewart, George Moriarty, Albuquerque, N.Mex. (Age 22.) Refers to J. H. Dorroh, R. H. A. Rupkey.

Stompler, Vernon Floreino, Langhorne, Pa. (Age 25.) Refers to D. M. Griffith, O. L. King.

Stone, Courtney Leo, Bradford, Pa. (Age 27.) Refers to A. Diefendorf, L. C. McCandliss.

Straub, Conrad Paul, Irvington, N.J. (Age 20.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

Strollo, George Francis, New York City. (Age 22.) Refers to L. V. Carpenter, A. Haring, C. T. Schwarze.

Sullivan, Arthur Bushnell, Alameda, Calif. (Age 23.) Steel Checker, Erection Dept., Bethlehem Steel Co. Refers to R. E. Davis, C. Derleth, Jr., B. A. Etcheverry, S. T. Harding, C. G. Hyde, C. T. Wiskocil.

Sundermeyer, John Karel, Hawthorne, N.J. (Age 24.) Draftsman, N. P. Nelson Iron Works, Inc., Allwood, N.J. Refers to R. C. Brumfield, F. E. Foss.

SUTER, WALTER EGLOFF, Beaumont, Tex. (Age 40.) Res. Engr., Texas State Highway Dept. Refers to R. C. Black, G. A. Bracher, C. H. Kendall, A. D. Schmid, G. D. Williams.

SWANSON, WALFRED ERNEST, Los Angeles, Calif. (Age 23.) Refers to R. R. Martel, W. W. Michael, F. Thomas.

SWENSON, RANDOLPH AUGUST, Brooklyn, N.Y. (Age 22.) Refers to H. E. Breed, L. V. Carpenter, C. T. Schwarze.

SYLVESTER, ROBERT OHRUM, Seattle, Wash. (Age 21.) Refers to I. L. Collier, C. W. Harris, C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

TABER, DOUGLASS, Cowlesville, N.Y. (Age 23.) Refers to W. R. Benford, L. T. Bohl, H. E. Miller.

TICE, RICHARD HOWELL, West Orange, N.J. (Age 23.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

TIETZE, IRVING BAYARD, JR., St. Louis, Mo. (Age 21.) With Phillips Petroleum Co., Bartlesville, Okla. Refers to A. H. Baum, Jr., H. K. Rubey, R. B. B. Moorman.

TINNEY, EDWARD LLEWELLYN, Yuba City, Calif. (Age 21.) Jun. Eng. Field Aid, California Dept. of Public Works, Div. of Highways, Dist. 3, Marysville, Calif. Refers to R. W. Carlson, J. B. Hodges.

TORRE, EDWARD FRANK, New York City. (Age 21.) Refers to H. E. Breed, L. V. Carpenter, A. Haring, F. A. Rossell, C. T. Schwarze, D. S. Trowbridge, S. F. Yasines.

TRUSTIN, HARRY, Omaha, Nebr. (Age 42.) Member of firm, Kraus & Trustin, Mfr. Agents, Fireproof building materials; also City Commr. and City Engr. Refers to W. H. Campen, G. P. Dorsey, C. L. Huff, H. D. Jolley, J. Latenser, Jr.

ULRICH, HAROLD EMIL, Austin, Tex. (Age 24.) Refers to E. C. H. Bantel, S. P. Finch, J. A. Focht, E. C. Gwillim.

UTTAL, SHELDON, New York City. (Age 20.) Refers to A. Haring, C. T. Schwarze, D. S. Trowbridge, S. F. Yasines.

VAN BERG, LEONARD LOWELL, Mercedes, Tex. (Age 21.) Refers to E. C. H. Bantel, J. A. Focht.

VAN DRIEST, EDWARD REGINALD, East Cleveland, Ohio. (Age 22.) Refers to G. E. Barnes, M. S. Douglas, G. B. Earnest, F. L. Plummer, G. B. Sowers.

VAN WERT, FRANKLIN STEVENS, Bemus Point, N.Y. (Age 24.) Refers to A. Diefendorf, L. C. McCandliss.

VESSELL, FRANK GEORGE, Minneapolis, Minn. (Age 23.) Refers to F. Bass, A. S. Cutler, J. I. Parcel.

VOLLAND, RICHARD EDWARD, Washington, D.C. (Age 21.) Steel Designer and Engr., Rosslyn Steel & Cement Co. Refers to A. N. Johnson, S. S. Steinberg.

VOLZ, LAWRENCE HENRY, Ft. Wayne, Ind. (Age 23.) Refers to C. A. Ellis, R. B. Wiley.

WALKER, RAY LESTER, Alameda, Calif. (Age 23.) Refers to W. H. Popert, C. T. Wiskocil.

WALLIN, HARRY NELS, Seattle, Wash. (Age 23.) Refers to C. C. More, F. H. Rhodes, Jr., R. G. Tyler, R. B. Van Horn.

WANKE, IRVIN ROBERT, Sparks, Nev. (Age 21.) Refers to F. L. Bixby, H. P. Boardman.

WARD, EDWARD REYNOLDS, City Island, N.Y. (Age 26.) Refers to W. Allan, J. C. Rathbun.

WEAVER, WALTER LESLIE, JR., Hannibal, Mo. (Age 22.) Refers to N. D. Morgan, C. E. Palmer.

WEISS, FREDERICK LOUIS, San Francisco, Calif. (Age 21.) Eng. Asst. to Walter L. Huber, Cons. Engr. Refers to J. I. Ballard, C. Derleth, Jr., B. A. Etcheverry, S. T. Harding, W. L. Huber, L. B. Reynolds, C. T. Wiskocil.

WILBY, FRANCIS BOWDITCH, New Orleans, La. (Age 53.) Div. Engr., Gulf of Mexico Div., U. S. Army. Refers to W. J. Barden, L. H. Beach, E. S. Bres, L. Brown, J. F. Coleman, J. P. Hogan, T. H. Jackson, J. C. H. Lee, R. M. McCrone, E. M. Markham, G. A. Youngberg.

WILDER, CARL RUDOLPH, Marshall, Tex. (Age 22.) Jun. Engr., Phillips Petroleum Co. Refers to A. L. Hyde, E. J. McCaustland, R. B. B. Moorman, H. K. Rubey.

WILKINSON, HOWARD METZGER, Long Branch, N.J. (Age 23.) Refers to H. N. Cummings, W. S. LaLonde, Jr.

WILSON, ROBERT ANTHONY, Chicago, Ill. (Age 26.) Jun. Engr., Pacific Flush-Tank Co. Refers to A. W. Hefling, R. E. Lawrence, W. C. McNown, F. A. Russell, H. E. Schlenz.

WOHLSEN, HERMAN FREDERICK, Lansdowne, Pa. (Age 22.) With Irving & Leighton of Philadelphia, Pa., at Canandaigua, N.Y. Refers to C. G. Dunnells, C. B. Stanton.

WOOLLISCROFT, EVERITT BENTLEY, Seattle, Wash. (Age 35.) Bridge Designer, Dept. of Highways, State of Washington. Refers to C. C. Arnold, F. W. Dencer, C. H. Eldridge, R. W. Finke, R. M. Murray, L. V. Murrow, M. K. Snyder.

WRIGHT, JAMES ANDERSON, Jr., New Orleans, La. (Age 22.) Refers to D. Derickson, W. B. Gregory, C. M. Kerr.

WRIGHT, SAMUEL ROBERT, Fort Worth, Tex. (Age 35.) Utility Engr. for City of Ft. Worth, Tex. Refers to C. T. Bartlett, E. B. Black, S. W. Freese, M. Hannah, W. O. Jones, D. L. Lewis, J. T. L. McNew, M. C. Nichols, J. W. Porter, J. J. Richey, F. M. Smith, Jr., J. H. Strange.

WROCKLAGE, JOHN FRANCIS, New York City. (Age 20.) Refers to T. Saville, C. T. Schwarze.

YAHYABEK, KHAIRY SAID, Cambridge, Mass. (Age 26.) Graduate student, Massachusetts Inst. of Technology. Refers to T. R. Camp, K. C. Reynolds, G. E. Russell, E. S. Sheiry, C. M. Spofford, J. B. Wilbur.

YARDLEY, ARTHUR JOHN, East Greenwich, R.I. (Age 22.) Refers to C. D. Billmyer, J. L. Murray.

YOUNG, CAMPBELL AUSTIN, Kansas City, Mo. (Age 45.) With Sheffield Steel Corporation. Refers to F. E. Brown, A. P. Clark, C. G. French, A. E. Lindau, A. P. Skaer, W. S. Thomson, F. J. Trelease.

FOR TRANSFER

FROM THE GRADE OF ASSOCIATE MEMBER

COTHER, ALBERT ADIEL, Assoc. M., Novosibersk, Siberia, U. S. S. R. (Elected April 1, 1908.) (Age 61.) Head, Mechanical Equipment and Top-Works Div., Project Dept., Kuzbasshaftstroy, Novosibersk, Siberia. Refers to E. C. H. Bantel, E. E. Howard, M. Rosner, J. C. Sanderson, I. F. Stern, T. U. Taylor, J. A. L. Waddell.

DAVIS, EDWARD THOMAS, Assoc. M., Verona, Pa. (Elected Oct. 1, 1928.) (Age 38.) With the J. N. Chester Engrs. and The Chester Engrs. Refers to J. T. Campbell, J. N. Chester, D. E. Davis, F. M. McCullough, H. A. Thomas.

GRUMM, FRED JUSTUS, Assoc. M., Sacramento, Calif. (Elected Jan. 13, 1919.) (Age 51.) Engr. of Surveys & Plans, State Div. of Highways, Dept. of Public Works. Refers to T. A. Bedford, B. N. Bryan, A. Givan, E. Hyatt, F. W. Panhorst, C. S. Pope, T. E. Stanton, Jr.

HAWTHORN, GEORGE EDWARD, Assoc. M., Seattle, Wash. (Elected Oct. 12, 1925.) (Age 46.) Asst. Prof. of Civ. Eng., Univ of Washington. Refers to M. E. Clark, C. W. Harris, T. D. Hunt, C. C. More, M. O. Sylliaasen, R. G. Tyler, R. B. Van Horn.

KAUPKE, CHARLES LEWIS, Assoc. M., Fresno, Calif. (Elected April 20, 1925.) (Age 51.) Water Master, Kings River Water Association. Refers to H. Barnes, H. K. Fox, H. L. Haehl, S. T. Harding, E. Hyatt, G. L. Swendsen.

MALCOM, VINCENT VALENTINE, Assoc. M., Cincinnati, Ohio. (Elected Junior March 5, 1928; Assoc. M. April 7, 1930.) (Age 36.) Engr., Highway Dept., The Philip Carey Co. Refers to T. R. Agg, R. A. Caughey, H. F. Clemmer, C. V. R. Fullenwider, A. H. Fuller, H. C. Jussen, A. R. Smith.

SWINTON, ROY STANLEY, Assoc. M., Ann Arbor, Mich. (Elected Junior May 2, 1911; Assoc. M. Sept. 11, 1917.) (Age 49.) Asst. Prof. of Eng. Mechanics, Coll. of Eng., Univ. of Michigan. Refers to L. E. Ayres, W. J. Emmons, L. M. Gram, C. W. Hubbell, F. N. Menefee, H. E. Riggs, R. H. Sherlock, H. A. Shuptrine, J. S. Worley.

TROXELL, GEORGE EARL, Assoc. M., Berkeley, Calif. (Elected Feb. 25, 1924.) (Age 40.) Associate Prof. of Civ. Eng., Univ. of California; also Structural Designer on various structures. Refers to R. E. Davis, C. Derleth, Jr., B. A. Etcheverry, S. T. Harding, E. Hyatt, C. G. Hyde, J. Rosenwald.

WHITMORE, GEORGE DEWEY, Assoc. M., Knoxville, Tenn. (Elected July 5, 1925.) (Age 38.) Chf. of Surveys (Prin. Cadastral Engr.), Eng. Surveys Soc., Eng. Service Div., TVA, Refers to U. N. Arthur, S. Baker, E. R. Polley, R. H. Randall, N. H. Sayford, H. A. Wiersema.

FROM THE GRADE OF JUNIOR

ASH, ARLINGTON DARWIN, Jun., Washington, D.C. (Elected July 14, 1930.) (Age 33.) Asst. Engr., U. S. Geological Survey, Water Resources and Power Branch, Middle Atlantic States Dist. Refers to J. A. Anderson, N. C. Grover, A. H. Horton, J. C. Hoyt, H. W. King, C. G. Paulsen.

BAKER, RUSSELL CURTIS, Jun., Vicksburg, Miss. (Elected Oct. 26, 1931.) (Age 31.) Associate Engr., U. S. Engr. Office. Refers to O. G. Baxter, F. G. Christian, G. R. Clemens, P. E. Cunningham, T. B. Larkin, G. H. Matthes, N. R. Moore.

BARNES, DONALD PORTER, Jun., Denver, Colo. (Elected March 10, 1930.) (Age 29.) Associate Engr., Denver Hydr. Laboratory, U. S. Bureau of Reclamation. Refers to C. E. S. Bardsley, J. Hinds, E. W. Lane, C. E. Pearce, J. L. Savage, F. Thomas, J. E. Warnock.

BISCHOF, GEORGE PAUL, Jun., Brooklyn, N.Y. (Elected July 16, 1928.) (Age 32.) Asst. Superv. Engr., WPA, Dept. of Hospitals, New York City. Refers to D. G. Edwards, J. H. C. Gregg, W. K. Peasley, H. H. Shepard, D. Standley, M. T. Staples.

BUNNELL, ARTHUR VALENTINE, Jun., Westfield, N.J. (Elected Dec. 3, 1928.) (Age 32.) Designer and Detailer with Engr. of Structures, New York Central R.R., New York City. Refers to J. H. Angen, J. B. Porter, H. D. Robinson, F. R. Schmid, Z. H. Sikes, D. B. Steinman, H. T. Welty.

FREITAS VALLE FILHO, JOSE DE, Jun., São Paulo, Brazil. (Elected Nov. 14, 1927.) (Age 32.) Cons. Engr., Directoria da Revista, Secretaria da Fazenda. Refers to J. T. de Oliveira Penteado, T. A. Ramos, V. da Silva Freire, C. Q. Simoes (Applies in accordance with Sec. 1, Art. I, of the By-Laws.)

HARVEY, GORDON WHITE, Jun., Babylon, N.Y. (Elected April 20, 1925.) (Age 33.) Park Engr., State of New York Transit Comm., New York City. Refers to H. Heins, A. E. Howland, W. K. Koch, O. F. Lewis, T. E. Ringwood, W. L. Selmer, S. Shapiro.

JAKKULA, ARNE ARTHUR, Jun., Ann Arbor, Mich. (Elected Jan. 16, 1928.) (Age 32.) Asst.

Prof. of Civ. Eng., Univ. of Michigan. Refers to J. H. Cissel, E. L. Eriksen, L. M. Gram, W. S. Housel, J. I. Parcel, R. H. Sherlock, J. A. Van den Broek.

KENNOY, JOHN SHARP, Jun., Sheffield, Ala. (Elected April 23, 1928.) (Age 32.) Concrete Inspector, TVA, Joe Wheeler Dam, Ala. Refers to N. A. Bowers, W. J. Carrel, D. W. Cole, J. R. Drummy, W. M. Hall, H. B. Hammill, J. P. Laws, D. V. Terrell.

LASKOWSKI, JOHN, Jun., Helena, Mont. (Elected Nov. 14, 1927.) (Age 31.) Jun. Hydrographic and Geodetic Engr., Chf. of Party, U. S. Coast & Geodetic Survey. Refers to W. Bowie, A. D. Boyd, E. F. Chandler, F. L. Peacock, F. B. T. Siems.

ORR, GERRY MITCHELL, Jun., Oklahoma City, Okla. (Elected Feb. 19, 1934.) (Age 27.) Head of Review Sec., Inspection Div., PWA. Refers to H. R. Carter, A. M. Lund, P. G. Pettersen, J. R. Rhyne, V. H. Smith, R. A. Sturgeon, G. Whittenberg.

SOLOMON, MORTON, Jun., Scarsdale, N.Y. (Elected Aug. 17, 1931.) (Age 33.) Engr., P. J. Carlin Constr. Co., New York City. Refers to E. K. Abberley, J. P. Carlin, M. N. Clair, R. E. Goodwin, H. T. Noyes, H. H. Snyder, A. C. Stiefel.

TILSON, GEORGE HENRY, Jun., Rosebank, N.Y. (Elected March 15, 1926.) (Age 32.) Asst. Engr., Grade Crossing Dept., New York Central R.R., New York City. Refers to R. F. Bessey, S. C. Gordon, W. C. Lancaster, J. E. Porter, N. D. Richardson, L. E. Robbe, F. R. Schmid, Z. H. Sikes, A. O. Van Suetendael, H. E. Wessman.

WURZ, ARNOLD, Jun., Clarksdale, Miss. (Elected Oct. 14, 1929.) (Age 29.) Supt., U. S. Dept. of Agriculture, Soil Conservation Service, Camp SCS-12, Coffeeville, Miss. Refers to E. Abbott, Jr., C. G. Conley, H. C. Dietzer, D. M. McCain, H. V. Pittman.

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men Available

These items are from information furnished by the Engineering Societies Employment Service, with offices in Chicago, New York, and San Francisco. The service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 87 of the 1936 Year Book of the Society. To expedite publication, notices should be sent direct to the Employment Service, 31 West 39th Street, New York, N.Y. Employers should address replies to the key number, care of the New York Office, unless the word Chicago or San Francisco follows the key number, when it should be sent to the office designated.

Construction

CONSTRUCTION ENGINEER; Assoc. M. Am. Soc. C.E.; 30; married; 8 years diversified experience, railroad, bridge, municipal, and general heavy construction. Thoroughly familiar with basic design and construction of grade-crossing eliminations. Last 2 years in responsible charge of construction of dam and water supply project. Desires connection with active engineering or construction organization. D-4718.

Design

ASSISTANT STRUCTURAL ENGINEER, BONNEVILLE PROJECT; Assoc. M. Am. Soc. C.E.; with U. S. Engineers; 16 years experience on highways, rivers and harbors, structural design, building construction, public utilities, railroad location, hydraulics, and administration; seeks employment on Pacific Coast or in western states after July 15; graduate of University of Washington; 44 years old; Washington license. D-5231.

CIVIL ENGINEER—SANITARY; Jun. Am. Soc. C.E.; university degree; age 30; married; 6 years engineering experience. Design and construction of small sewerage plants, water treatment plants, and swimming pools; general office engineering; concrete design; excellent draftsman; employed now; available on short notice. D-5234.

Executive

CONSULTING ENGINEER, CHICAGO, ILL.; M. Am. Soc. C.E.; 50; married; graduate civil engineer; Illinois-registered structural engineer; 28 years experience, large industrial plants, commercial building projects, appraisals, reports, etc.; established name in Chicago; available for association, or employment, with responsible engineering or construction organization. Will consider other desirable locations. B-7647.

HIGHWAY ENGINEER; M. Am. Soc. C.E.; 50; married; graduate civil engineer; 23 years experience, highway and bridge construction; 8 years experience as chief engineer and administrative head of a western state highway department. Desires position with city, county, or state organization, preferably on Pacific Coast. Available immediately. D-5212-366-A-6-San Francisco.

CHEMICAL AND SANITARY ENGINEER; Assoc. M. Am. Soc. C.E.; 30; married; graduate of Massachusetts Institute of Technology; 9 years local and foreign experience. Design, construction, and operation of public and industrial water-treating plants; iron removal; sewage and industrial waste disposal; good record; excellent references. Now employed; available. Satisfaction guaranteed. D-4895.

ESTIMATING ENGINEER; Assoc. M. Am. Soc. C.E.; 40; B.S. in C.E.; 10 years field experience in engineering and construction; 14 years as executive office engineer and building cost estimator. For 10 years employed by one of country's largest building contractors, in full charge of estimating. Would like permanent position with high-class company. B-1141.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; graduate of University of Iowa; 1 year teaching fellowship in civil engineering, University of Minnesota; German-American; married with family; age 32; average weight and height; 7 years experience in highway and civil engineering; wishes connection with good company or its equivalent. Location immaterial. References. C-3977.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 20 years experience, drainage, highway, railroad, and contractor's engineer; estimating, bidding jobs, superintendent of construction; on dredging, earth moving, bridges, drainage structures, foundations, docks, and sewers. Familiar with floating equipment. Available on about two weeks' notice. Southern states preferred. D-3490.

BUILDER'S AND CONTRACTOR'S ENGINEER; Assoc. M. Am. Soc. C.E.; age 39; thoroughly experienced with best firms on sales, estimates, purchases, designs including falsework, construction, surveys, on large buildings (public and private), also bridges, tunnels, highways; desires connection. C-6480.

GRADUATE SANITARY ENGINEER; Assoc. M. Am. Soc. C.E.; 29; Pennsylvania State College; 7 years experience in design, surveys, and inspection of highways and bridges. Desires position in either civil or sanitary engineering, field or office. D-4919.

ENGINEER; M. Am. Soc. C.E.; with 30 years experience in engineering, maintenance of way, valuation, and executive departments of steam railroads—last 9 years on work requiring study and inspection of many of the railroads of the United States and Canada; desires connection in New York metropolitan area. D-4841.

ENGINEER; Assoc. M. Am. Soc. C.E.; long experience in construction business and corporate organizations; highly familiar with reinforced concrete in modern railroad structures, highway structures, special foundations, and pre-cast work. Design, construction, and operation of crushed stone, gravel and construction plants, including machinery and purchasing. Mexican experience. Agreeable personality. Eastern United States. D-5240.

Junior

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 29; single; A.B. degree, Columbia University; B.S.C.E., University Colorado; 2 years highway experience; 2 years small, private home building; 1 year inspector, later personnel employment work, PWA and Home Relief Bureau, New York; now employed in foreign sewage survey; knowledge of Arabic, familiar with Arab labor; location immaterial. D-2611.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 30; married; B.S. in C.E., Rutgers University, 1930; 2 years as transitman with Essex County Highway Department. Desires opportunity in any branch of civil engineering. Will go anywhere in New Jersey and neighboring states. Available in 15 days. D-663.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; college graduate; 10 years practical experience; private license to fly; knowledge of aerial photography and aerial mapping. Desires position either as an engineer or in some phase of aerial mapping. Employed now; available in two weeks. D-2211.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28 B.S.C.E., Union College, 1929; 6 years engineering experience, including 4 months highway construction, $2^1/_2$ years office and field work (large building construction firm), special course in structural welding design, 3 years varied engineering and general construction. Desires position in any branch of civil engineering. Available. D-189.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; married; B.S.C.E., University of Illinois, 1930; $2^2/_3$ years as junior highway engineer, Illinois Division of Highways—drafting, proportioning engineer, inspecting, surveying; $2^1/_2$ years reserve officer on active duty with CCC, administrative and executive experience. Desires civil engineering position. Location immaterial. Available 15 days. D-4926.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; single; licensed surveyor, New Jersey; 2 years surveying (general and precise); $1^1/_2$ years, U. S. Department of Agriculture as junior agricultural engineer. Desires opportunity of making a new connection. D-3316.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; single; 23; B.S. (civil), University of Missouri, 1935; 4 months experience as rodman, Missouri Highway Department; 1 month as road contractor; 4 months as junior civil engineer, U. S. Forest Service; 3$^1/_2$ months as instrumentman on state park survey; desires position in any branch of civil engineering; location immaterial; available immediately. D-4735.

SALES

SALES AND DESIGNING ENGINEER; Assoc. M. Am. Soc. C.E.; American Chemical Society; registered, specializing in petroleum, gasoline plants, field equipment; wide acquaintance mid-continent and Rocky Mountain areas; intimate knowledge of field conditions and new developments. Seeks position with manufacturer, established engineers, banking or insurance house, valuations and checking royalties. D-4893.

SALES ENGINEER; M. Am. Soc. C.E.; registered engineer, Pennsylvania; over 20 years practical and technical experience in sales, designs, and estimates with a leading steel fabricating company. Can offer very successful record. Prefers western Pennsylvania and Ohio district. C-5095.

TEACHING

INSTRUCTOR, CIVIL AND HIGHWAY ENGINEERING; Jun. Am. Soc. C.E.; 31; single; C.E. degree, Pennsylvania State College; majored in highway engineering; minored in city planning and city managership; 5 years in highway engineering, surveys, design, construction, research; 2 years as instructor (engineeing mathematics) experienced tutor; public speaker; engineering publicity, publication work; university faculty position desired, with opportunity for research study. D-2776.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 29; B.S., U. S. Military Academy; C.E., M.C.E., Sigma Xi, Cornell University; experience in flood control studies, hydrology, hydraulic research, river improvement, economics of river improvements, organization for and direction of such studies. Desires responsible teaching position. Interested in research. Location immaterial. D-4234.

UNIVERSITY INSTRUCTOR; Assoc. M. Am. Soc. C.E.; desires a position as assistant professor with an opportunity to teach sanitary engineering. Has had 13 years teaching experience. Master's degree in sanitary engineering. B-7785.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 35; married; graduate, Ohio State University; Ohio license; 12 years experience, municipal, sanitary, hydraulic, and structural; 8 years charge of office force on design and preparation of plans of sewage works; employed; prefers midwest location. Available on reasonable notice. D-5248.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 77 of the Year Book for 1936. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

L'ANALYSE MÉCANIQUE, Tamisage—Sédimentation—Lévigation. By H. Gessner, translated from the German by J. P. Buffle. Paris, Dunod, 1936. 270 pp., illus., diagrs., charts, tables, 8 × 5 in., cloth, 48 frs.

This translation of Gessner's Schlämmanalyse will be useful to those who read French more readily than German. The book provides an excellent review of the theory underlying mechanical analysis and of the practical methods used in examining soils, clays, cements, and other materials.

DESIGN OF REINFORCED CONCRETE STRUCTURES. By D. Peabody. New York, John Wiley & Sons, 1936. 457 pp., diagrs., charts, tables, 9 × 6 in., cloth, $4.

This book has been written for use in a course of 270 hours of lecture and problem work given at the Massachusetts Institute of Technology. It aims to explain in a consecutive manner the multitudinous details that make a reinforced concrete design, in a sufficiently expanded manner to relieve the student of note taking. The presentation of theory is accompanied by illustrative problems, each of which is the design of some unit and which collectively form the essentials for the design of a complete building.

ENGINEERING VALUATION. By A. Marston and T. R. Agg. New York and London, McGraw-Hill Book Co., 1936. 655 pp., charts, tables, 9 × 6 in., cloth, $6.

The basic principles underlying the valuation of industrial properties are set forth in this book, and their application illustrated by specific examples. A synopsis of all the controlling decisions of the U. S. Supreme Court which affect the practice of valuation is included, and a new principle of depreciation is developed. Numerous tables are included. The book is an admirable treatise, comprehensive and up-to-date, which will fill the needs of many engineers.

Great Britain, Dept. of Scientific and Industrial Research, BUILDING RESEARCH, Technical Paper No. 19, CARBONATION OF UNHYDRATED PORTLAND CEMENT, by D. G. R. Bonnell. London, His Majesty's Stationery Office, 1936. 59 pp., diagrs., charts, tables, 10 × 6 in., paper, 1s. (obtainable from British Library of Information, New York, 35 cents).

When portland cement is stored in such a manner that air has access to it, changes take place in it which usually have a deleterious effect upon its properties. The present investigation was undertaken to determine the extent to which carbon dioxide is responsible for these changes. The results so far obtained are presented in detail.

HISTORY OF AMERICAN SAILING SHIPS. By H. I. Chapelle. New York, W. W. Norton & Co., 1935. 400 pp., illus., diagrs., 11 × 8 in., cloth, $7.50 ($27.50 limited edition).

This unusually attractive volume provides a comprehensive account of the evolution of the American sailing ship from the beginning of shipbuilding to the present day. Naval craft, privateers and slavers, revenue cutters, the schooner, merchant craft, and yachts are discussed. The illustrations include a series of detail plans of important ships, most of which are published for the first time.

AN INTRODUCTION TO THE THEORY OF ELASTICITY FOR ENGINEERS AND PHYSICISTS. By R. V. Southwell. New York, Oxford University Press, 1936. 509 pp., illus., diagrs., 10 × 7 in., cloth, $10.

It was the purpose of the author to bridge the gap between "elementary" texts and the authoritative but difficult books of Love and Rayleigh. The bridge is necessary, because more and more physicists and engineers are being forced into advanced study of the theory of elasticity by contemporary developments in engineering. This "introduction"—it goes far into the field—should be especially useful because of the familiarity of its notation, its wealth of practical problems and examples, and its high ratio of text to equations. There is an extensive bibliography and an adequate index.

MEN OF SCIENCE. By J. G. Crowther. New York, W. W. Norton & Co., 1936. 332 pp., illus., diagrs., 9 × 6 in. cloth, $3.50.

The book contains interesting biographies of a group of English physicists—Davy, Faraday, Joule, Thomson, and Maxwell—who lived in England in the same century and contributed vastly to scientific advance. In addition to presenting their scientific achievements, this book examines their relation to the social and intellectual life of the times, and considers the effects of social and industrial forces upon their work.

MITTEILUNGEN AUS DEM INSTITUT FÜR BAUSTATIK AND DER EIDG. Technischen Hochschule in Zürich. Mitteilung Nr. 6. BIEGUNGSBEANSPRUCHUNG DER RECHTECKIGEN PLATTE ALS WAND EINES FLÜSSIGKEITSBEHÄLTERS, by H. Fritz. Zürich and Leipzig, Verlag A. G. Gebr. Leeman & Co., 1936. 81 pp., diagrs., charts tables, 9 × 6 in., paper, 4.80 Swiss frs. or 4 m.

This pamphlet discusses the stresses in large rectangular slabs of reinforced concrete, such as are often used for the walls of rectangular plates. A method of calculation, which enables the designer to arrive at satisfactory designs with certainty and to determine the most economic form for rectangular tanks, is developed.

PRÉVISION DU TEMPS PAR L'ANALYSE DES CARTES MÉTÉOROLOGIQUES. By J. Van Mieghem. Paris, Gauthier-Villars & Cie., 1936. 138 pp., illus., diagrs., charts, tables, maps, 10 × 6 in., 35 frs.

This book, by a meteorologist of the Belgian Weather Bureau, discusses the present state of scientific weather forecasting. The methods described are based upon the work of the Norwegian School of Meteorology, and consist in the application of the laws of mechanics and physics to the analysis of weather maps.

PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING, June 22 to 26, 1936. 2 vols. Cambridge, Graduate School of Engineering, Harvard University, 1936. Vol. I, 327 pp.; Vol. II, 330 pp., illus., tables, diagrs., charts, 11 × 8$^1/_2$ in., paper, $10 for the three volumes (Vol. III will be issued later).

These volumes include reports from soil mechanics laboratories, here and abroad, on testing apparatus, the technique of testing, and investigations in progress. They also include a wealth of material on soil properties and conditions; stress distribution in soils; settlement of structures; the stability of earth and foundation works; the bearing capacity of piles; pile loading tests; earth pressure against retaining walls, tunnel linings, etc.; modern methods of designing and constructing foundations; and numerous allied subjects.

REINFORCED CONCRETE DESIGN. By G. P. Manning. 2 ed. London, New York, and Toronto, Longmans, Green & Co., 1936. 497 pp., diagrs., charts, tables, 9 × 6 in., 21s ($7.50).

This book is "based on the methods which the author has found in use and which he has himself used in actual work." He first treats of the cross-sections of members and their stresses; then of members as a whole, including circular tanks, piles, floors, and staircases; and finally of the design of complete structures. Throughout the book, the emphasis is upon practical designing. The new edition has been partly rewritten, and the arithmetical data have been revised.

SEWERAGE—the Designing, Constructing, and Maintaining of Sewerage Systems and Sewage Treatment plants. By A. P. Folwell. 11 ed. New York, John Wiley & Sons; London, Chapman & Hall, 1936. 412 pp., illus., diagrs., charts, tables, 10 × 6 in., cloth, $4.50.

The new edition of this well-known treatise is intended, like former ones, to present recognized good practice in the design and construction of sewerage systems and sewage disposal plants, in a concise, practical way. The chief change in this edition is the revision of the section devoted to sewage treatment, but some recent information has also been added on other subjects.

TUNNELLERS, the Story of the Tunnelling Companies, Royal Engineers, During the World War. By W. G. Grieve and B. Newman. London, Herbert Jenkins, Ltd., 1936. 334 pp., illus., diagrs., maps, 9 × 6 in., cloth, 15 s.

A history of the organization and achievements of the tunneling companies of the Royal Engineers during the World War. These companies, recruited from British miners, were organized early in 1915 and rendered effective service until the end of the war. The story of their achievements is well told.